Marine Research

SCOTTISH HOME DEPARTMENT

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**1958 No. 1**

# The Ecology of Scottish Inshore Fishing Grounds

## 1. The Bottom Fauna of East Coast Grounds

by A. D. McINTYRE, B.Sc.

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# The Ecology of Scottish Inshore Fishing Grounds

## 1. The Bottom Fauna of East Coast Grounds

### INTRODUCTION

Many fish species of commercial importance depend for their food largely on the benthos. In recent years a series of investigations has been made from the Marine Laboratory, Aberdeen, on the bottom fauna of certain fishing grounds off the Scottish east coast. The object was to study the quantity, fluctuations and production of the benthos, and to consider these points in relation to the feeding of fish. The gears used were grabs, dredges, trawls and an underwater camera. The grounds studied were the St. Andrews Bay area, the coastal stretch north of Aberdeen and the Smith Bank area of the Moray Firth.

In order to obtain a comparison of the three grounds unbiased by seasonal changes, a survey was made in July 1954 during which all three areas were sampled within a period of three days. The results of the survey, which are described in this report, give quantitative data on the mid-summer standing crop of the benthos and provide the necessary background against which other problems, connected with fluctuations, production and the feeding of fish, will be considered in subsequent reports.

### METHODS

In each area, after an extensive preliminary survey with a small grab to determine the nature of the grounds, a number of representative stations was selected—twenty in the St. Andrews area, twenty off Aberdeen and twelve on or near Smith Bank. At each station one sample was taken with a van Veen type grab (with endless warp rig) covering $1/5m^2$ surface area and weighted to 268 lb (112 kg) in use. Samples of less than three litres were rejected. In practice the volume of deposit varied from 4 to 18·5 litres, the mean being 9·4 litres. The soil from each sample was washed through a sieve with round holes of approximately 1·3 mm diameter, and the residue was preserved in 7% formalin.

At most stations a soil sample of about 300 cc was removed from the grab before sieving. The animals were extracted from this and returned to the main sample, after which the soil was dried. Mechanical analysis of these samples was done by the staff of the Macaulay Research Institute, Aberdeen, and I wish to thank the Director, Dr. O. N. McArthur, and Dr. H. R. M. Hardie for their co-operation. The results of the analysis are given in Appendix II. There are disadvantages in using agricultural methods of soil analysis in marine work, and this question has recently been discussed by Morgans (1956). Nevertheless, the straightforward mechanical analysis is of much more value than a purely subjective description of the soil.

In the laboratory all animals were extracted from the main samples, identified, counted, and stored in 7% formalin buffered with borax. During the first examination the "formalin weight" was measured. This is the weight of the animals after roughly drying off the surface moisture with blotting paper. It includes the shells of molluscs and other calcareous matter such as the tests of echinoderms. Finally the dry weight was obtained. This was measured after drying the tissue at 110°C to constant weight. Calcareous matter was not included in the dry weight—the shells of molluscs were removed before drying and other animals with calcareous matter were first treated with dilute hydrochloric acid. *Echinocardium cordatum* usually had a considerable quantity of sand in the gut and for this species the residue after acid treatment was ignited and the weight of sand subtracted. For all other species the dry weight includes any sand present in the body.

Information on the larger or more active fauna was obtained from series of samples over the sa grounds between 1951 and 1955 using a 6 ft Agassiz trawl and an "Aberdeen" type 30 ft otter trawl. T sampling is discussed on p. 11.

Except where otherwise stated (see Notes on Certain Species, p. 13) the nomenclature is that of t Plymouth Marine Fauna (M.B.A. 1957).

I wish to acknowledge the help of the following authorities in the identification of certain grou Dr. A. C. Stephen (anemones and gephyreans), Dr. C. Burdon-Jones (Enteropneusta), Mr. J. A. All (*Nucula*) and Mr. N. Tebble (polychaetes).

## DESCRIPTION OF GROUNDS

The ground studied in the St. Andrews Bay area is shown in Fig. 1. It lies between Babbet Ness the south and the sand banks at the mouth of the river Tay in the north, and extends seaward towar the Bell Rock, covering an area of roughly 50 sq. miles. The bottom slopes gently so that the 20 fatho line is in places 15 miles from low water mark. The river Eden discharges into the southern part of t area and the Tay into the northern. The inner stations are well sheltered by the land and have a fi deposit, 13 of the samples having more than 9% silt and clay. The annual ranges of bottom temperatu and salinity over the past ten years were 4·84-12·41°C and 34·19-34·78‰ respectively.

The area sampled off the Aberdeenshire coast (Fig. 2) extends from the river Dee in the south to t river Ythan in the north, a distance of roughly ten miles. The depth contours run roughly parallel the coast, and the bottom slopes more steeply than in the St. Andrews area, so that the 30 fathom line just under five miles from low water mark. There is little shelter, the area being open to winds from nort east to south-west, and strong tidal streams occur. The bottom is fairly uniform, of clean hard san becoming mixed with mud in the deeper water. The soil is rather coarser than in St. Andrews Ba only one of the samples having a silt and clay fraction exceeding 9%. Over the past ten years the rang of temperature and salinity at the bottom were 4·70-12·36°C and 33·25-34·44‰ respectively.

Smith Bank (Fig. 3) is in the north-west corner of the Moray Firth, about ten miles off Clythne The shallowest part of the bank is just under 20 fathoms and the bottom is largely of clean sand, co siderably coarser than that in either of the other two areas—no station on the bank having more tha 0·6% silt and clay. Patches of stony ground with rocky outcrops occur particularly on the northe part of the bank and small patches of shell gravel are found irregularly scattered over the whole are Between the bank and the coast the bottom slopes down to a muddy channel which reaches 40 fathor at its deepest part. The ranges of temperature and salinity on the bank over the past ten years we 5·99-12·00°C and 34·59-34·99‰ respectively.

The detailed positions and depths of all stations are given in the station list in Appendix I.

The areas samples off St. Andrews and Aberdeen are fished by seine net vessels which catch main plaice. The commercial fishery on Smith Bank depends rather on gadoids—cod mainly in the spri and haddock in all seasons but particularly in late summer.

## QUANTITATIVE SAMPLES

### The Fauna of the St. Andrews Bay Area

The numbers of each species collected from the twenty stations in this area are given in Appendix III, and the dry weights and numbers of the main animal groups are summarised in Table I.

TABLE I

St. Andrews area. Dry weights in gm (per 1/5m²) of the main animal groups at each station. The numbers of individuals are given in brackets.

| Station | Mollusca | Polychaeta | Echinodermata | Other groups | Total dry weight |
|---|---|---|---|---|---|
| 1 | 0·209 (66) | 0·186 (95) | 0·021 (4) | 0·004 (16) | 0·420 |
| 2 | 0·074 (65) | 0·140 (47) | 0·110 (1) | 0·003 (9) | 0·327 |
| 3 | 0·057 (51) | 0·266 (71) | 0·250 (2) | 0·009 (13) | 0·582 |
| 4 | 0·092 (103) | 0·144 (35) | — | 0·001 (7) | 0·237 |
| 5 | 0·055 (48) | 0·044 (19) | 0·002 (2) | 0·003 (2) | 0·104 |
| 6 | 0·216 (135) | 0·221 (65) | 2·568 (18) | 0·005 (8) | 3·010 |
| 7 | 0·487 (111) | 0·261 (75) | 0·092 (4) | 0·001 (4) | 0·841 |
| 8 | 0·433 (144) | 0·195 (79) | 0·552 (6) | 0·006 (13) | 1·186 |
| 9 | 0·097 (172) | 0·130 (95) | 0·161 (2) | 0·005 (10) | 0·393 |
| 10 | 1·492 (215) | 0·231 (90) | 0·220 (3) | 0·092 (4) | 2·035 |
| 11 | 0·159 (85) | 0·078 (44) | 0·115 (2) | 0·011 (4) | 0·363 |
| 12 | 0·121 (101) | 0·125 (36) | 1·096 (8) | 0·002 (9) | 1·344 |
| 13 | 0·033 (26) | 0·110 (27) | 0·020 (2) | 0·005 (4) | 0·168 |
| 14 | 1·156 (116) | 0·400 (162) | 1·380 (123) | 0·048 (12) | 2·984 |
| 15 | 0·109 (65) | 0·136 (23) | 0·563 (2) | 1·745 (3) | 2·553 |
| 16 | 0·101 (85) | 0·162 (29) | 0·169 (1) | 0·002 (6) | 0·434 |
| 17 | 0·229 (201) | 0·096 (57) | 0·012 (2) | 0·002 (7) | 0·339 |
| 18 | 0·397 (178) | 0·123 (35) | 0·330 (4) | 0·003 (15) | 0·853 |
| 19 | 0·096 (159) | 0·055 (42) | 0·163 (2) | 0·001 (9) | 0·315 |
| 20 | 0·075 (87) | 0·064 (32) | 0·102 (4) | 0·035 (15) | 0·276 |

The fauna was dominated by molluscs, of which 25 species were found. These averaged 111 individuals (mainly lamellibranchs) per station, giving a mean dry weight of 0·285 gm per 1/5m². More than half of the weight was made up of four species, *Abra alba* (28%), *Tellina fabula* (12%), *Nucula turgida* (9%) and *Ensis* sp. (9%). Three other species, *Abra prismatica*, *Venus striatula* and *Thyasira flexuosa*, were numerically abundant, but contributed little to the biomass because of their small size. The 10 fathom contour divides the area sampled into two approximately equal parts. *Abra alba* was about four times and *Tellina fabula* about twice as abundant in the shallow water as in the deep. *Nucula turgida* on the other hand was rather more numerous in the deeper outer part, and *Abra prismatica* and *Thyasira flexuosa* were almost entirely confined to this part. *Ensis* and *Venus* were distributed fairly evenly over the whole ground irrespective of depth.

Altogether 45 species of polychaetes were found, the mean number and dry weight per 1/5m² haul being 58 individuals and 0·158 gm respectively. More than half the weight was made up of *Nephthys* mostly *hombergi* (36%), *Notomastus latericeus* (15%) and *Sigalion mathildae* (8%). Other species present in large numbers but of small total weight were *Spiophanes bombyx*, *Goniada maculata*, *Magelona papillicornis*, *Scoloplos armiger*, and *Chaetozone setosa*. The distribution of *Nephthys* and *Scoloplos* was fairly even over the whole area, but *Goniada* was more abundant in the deeper water, while the other common worms occurred in greatest numbers in depths less than 10 fathoms.

Most notable among the echinoderms was a haul of 100 small *Amphiura filiformis* (disc diamete 2-8 mm) at station 14. *Echinocardium cordatum* was the only echinoderm found in more than a few haul The specimens were mainly between 20 and 30 mm long and only at stations 6 and 12 were they at a numerous—15 and 8 individuals respectively. The mean dry weight per haul for echinoderms w 0·396 gm and although this was higher than the corresponding values for either molluscs or polychaete it is due mainly to the large catches of *Echinocardium* and *Amphiura* at the three stations referred to abov

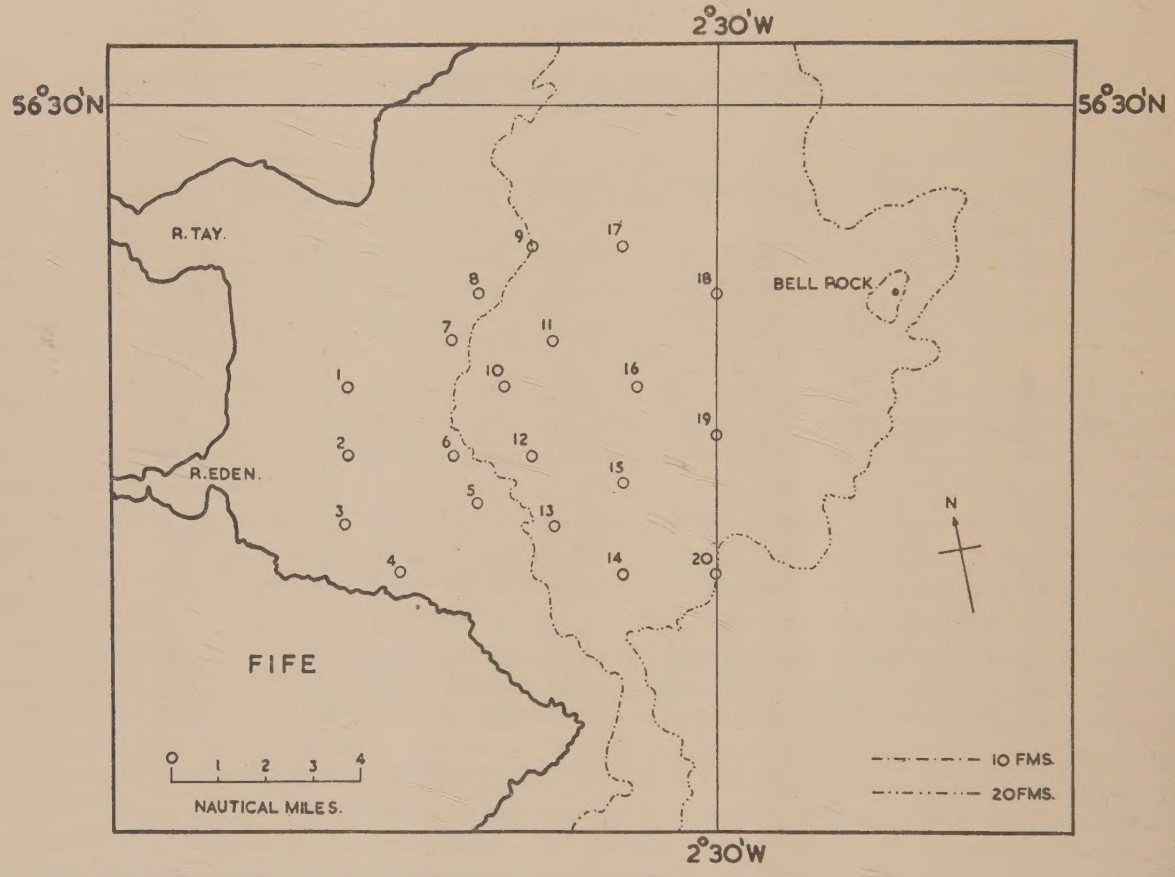


Fig. 1 Stations sampled in the St. Andrews area.

Among other groups of animals, young bottom stages of *Corystes cassivelaunus* were present at m stations, and amphipods, the commonest being *Ampelisca brevicornis*, *Harpinia antennaria* and *Hippomed denticulatus*, were found in all but four hauls. These groups, however, made no significant contributi to the biomass.

On the whole the fauna consisted of fairly small animals. Apart from the few *Echinocardium* alrea referred to, only four individuals weighed more than 1 gm formalin weight. These were *Mactra coralli* (station 10), *Dosinia lupinus* (station 14), *Corystes cassivelaunus* (station 15) and *Ensis* sp. (station 18). For t whole area the mean dry weight per square metre was 4·69 gm.

## The Fauna of the Aberdeen Coastal Area

The numbers of each species found in collections from the twenty stations in this area are given Appendix IV and the dry weights and numbers for the main animal groups are summarised in Table I

TABLE II

Aberdeen area. Dry weights in gm (per 1/5m²) of the main animal groups at each station. The numbers of individuals are given in brackets.

| Station | Mollusca | Polychaeta | Echinodermata | Other groups | Total dry weight |
|---|---|---|---|---|---|
| 1 | 0·386 (88) | 0·382 (41) | 0·481 (43) | 0·002 (21) | 1·251 |
| 2 | 1·596 (145) | 0·524 (102) | 0·154 (39) | 0·168 (39) | 2·442 |
| 3 | 0·747 (189) | 0·885 (135) | 0·247 (80) | 0·005 (43) | 1·884 |
| 4 | 0·528 (131) | 0·472 (73) | 0·093 (15) | 0·006 (20) | 1·099 |
| 5 | 1·912 (184) | 0·576 (85) | 0·110 (19) | 0·002 (26) | 2·600 |
| 6 | 1·033 (174) | 0·515 (77) | 0·829 (23) | 0·015 (36) | 2·392 |
| 7 | 0·392 (154) | 0·084 (68) | 0·161 (13) | 0·024 (23) | 0·661 |
| 8 | 0·262 (66) | 0·419 (22) | 0·949 (8) | 0·008 (3) | 1·638 |
| 9 | 0·329 (56) | 0·271 (35) | 0·114 (14) | 0·001 (6) | 0·715 |
| 10 | 0·852 (148) | 0·132 (31) | 0·131 (8) | 0·001 (6) | 1·116 |
| 11 | 0·567 (182) | 0·277 (45) | 0·376 (52) | 1·580 (3) | 2·800 |
| 12 | 1·065 (157) | 0·239 (76) | 0·124 (9) | 0·080 (82) | 1·508 |
| 13 | 0·207 (122) | 0·176 (54) | 0·094 (11) | 0·011 (16) | 0·488 |
| 14 | 0·253 (132) | 0·358 (62) | 0·001 (10) | 0·011 (19) | 0·623 |
| 15 | 0·082 (43) | 0·188 (34) | 0·212 (14) | 0·020 (23) | 0·502 |
| 16 | 0·180 (75) | 0·264 (38) | 0·120 (10) | 0·025 (32) | 0·589 |
| 17 | 0·347 (162) | 0·243 (51) | 0·276 (18) | 0·129 (44+) | 0·995 |
| 18 | 0·337 (82) | 0·317 (84) | 0·873 (13) | 0·121 (67+) | 1·648 |
| 19 | 2·321 (150) | 0·273 (68) | 0·501 (28) | 0·120 (92) | 3·215 |
| 20 | 0·080 (169) | 0·010 (56) | 0·118 (16) | 0·379 (131+) | 0·587 |

+ indicates large numbers of *Phoronis*

As before the fauna was dominated by molluscs. Twenty-eight species were found, the average number of individuals being 130 per 1/5m², with a corresponding dry weight of 0·674 gm. Just over half this dry weight was composed of *Tellina fabula* (33%) and *Nucula turgida* (17%). These two species, although present at almost every station, had clearly marked numerical differences in their distribution. *Tellina fabula* was most abundant at stations 1-7 which lay in the shallowest water (11-18 m depth) roughly in a line parallel to the coast. The sediment was rather coarse here, the coarse sand fraction being well represented and the silt-clay fraction varying between 2·2 and 4·8%. At these seven stations *T. fabula*, mainly individuals between 5-17 mm long, averaged 104 per sample (520 per m²) and made up 30% of the total dry weight. In the deeper water, not only was *T. fabula* less abundant, but the individuals were smaller in size. The only exception was at station 14, where the species was well represented (53 specimens) and it is significant that this station, in its soil characteristics and in the presence of large numbers of *Lanice* tubes, resembled those in shallower water. Deeper than 20 m *Nucula turgida* was dominant, and was particularly abundant at a group of five stations (numbers 10, 11, 12, 16 and 17) roughly in the middle of the area, where the average occurrence was 85 specimens per haul. These stations had a finer deposit than inshore—the bulk of the sediment was in the fine sand category, and the proportion of silt and clay varied from 4 to 11%. Of the other 23 species of molluscs, *Abra prismatica* was most abundant. It was found at all stations without any obvious centre of concentration, and averaged 10 specimens per haul. *Mysella bidentata* and *Montacuta ferruginosa* (in association with *Echinocardium cordatum*) had a patchy distribution over the whole area, while *Thyasira flexuosa* was more or less restricted (as off St. Andrews) to the deep water stations. *Venus striatula* was present in all hauls except two, but the individuals were mostly small, about 3 mm long. *Gari fervensis* also was represented mainly by juvenile stages, the eight specimens at station 12 being between 4 and 11 mm long. Station 18 was different from all others in the presence of eleven large *Dentalium entalis* and the absence of *Nucula turgida*.

There were 48 species of polychaetes in the Aberdeen samples the mean number of individuals and dry weight per 1/5m² being 62 and 0·330 gm respectively. A large part (79%) of the polychaete biomass

was made up of *Nephthys*, mostly *hombergi* (32%), *Lanice conchilega* (18%), *Sigalion mathildae* (11%), *Notomastus latericeus* (9%) and *Goniada maculata* (9%). *Nephthys* was dispersed fairly evenly over the whole area, but *Goniada* was most abundant in the deeper water, while *Lanice*, *Sigalion* and *Notomastus* were found mainly in the shallow stations of the *Tellina fabula* zone where large numbers of empty *Lanice* tubes covered the bottom. The following six species, although accounting for about 45% of the numerical total, made up only 8% of the weight because of their small size—*Spiophanes bombyx*, *Chaetozone setosa*, *Magelona rosea*, *Scoloplos armiger*, *Diplocirrus glaucus* and *Pholoë minuta*. Of these *Scoloplos* and *Magelona* were more or less evenly distributed, while *Spiophanes* and *Chaetozone* were most abundant in the shallow water and *Diplocirrus* and *Pholoë* in the deep. In general the mean weight per haul for polychaetes at stations under 20 m depth was about twice that for the deeper stations, and the numbers showed a similar trend.

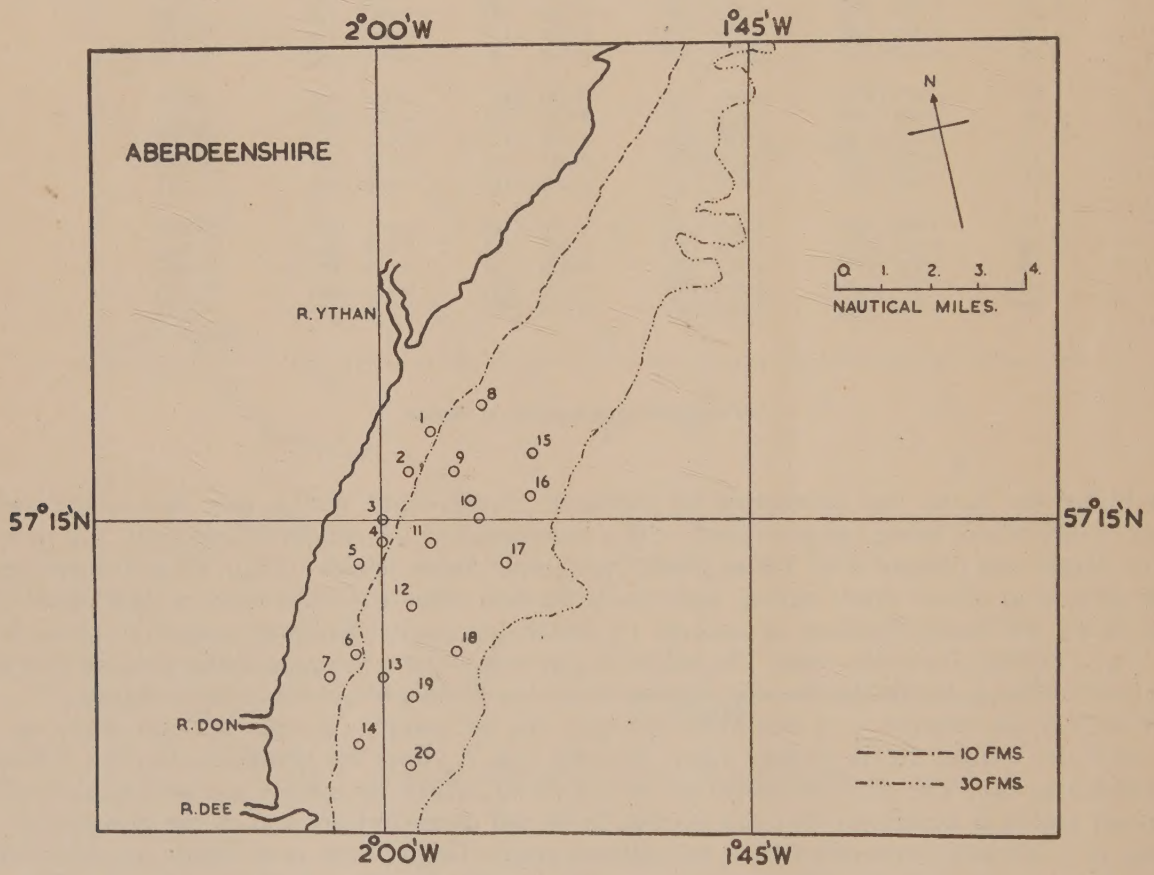


Fig. 2 Stations sampled in the Aberdeen area.

The echinoderms' mean dry weight was 0·298 per 1/5m² and the bulk of this was provided by *Echinocardium cordatum*. These were mostly young specimens between 8-15 mm long and averaged individuals per haul. Although found at all but three stations, they occurred in greatest numbers in the deeper water offshore. The only other echinoderm of note was *Ophiura texturata*. This was found mainly in the shallow *Tellina fabula* area, and was associated with large numbers of very small ophiuroids (disc diameter 2 mm and less) which were probably mainly juveniles of the same species.

Among the crustacea newly settled *Corystes* were found at most stations, while amphipods were taken

in all but one haul. Most numerous were *Ampelisca brevicornis*, *Nototropis swammerdami*, *Bathyporeia guilliamsoniana*, *Harpinia antennaria* and *Pariambus typicus*. However, with the exception of one *Portunus holsatus* the crustacea contributed little to the biomass.

A striking feature of the deeper stations (numbers 15-20) was the presence of juvenile stages of the anemone *Edwardsia* (61 individuals at station 20) and of large numbers of *Phoronis mulleri*, the empty tubes of which occurred in most samples from deep water.

As off St. Andrews, most of the fauna in the Aberdeen area consisted of small animals. Except for several *Echinocardium* the only individuals weighing more than 1 gm formalin weight were two *Mactra corallina* (16 gm) at station 9, *Portunus holsatus* (7·3 gm) at station 11, *Scaphander lignarius* (4·3 gm) at station 12, and a fragment of a large *Cyprina islandica* (47 gm) at station 19. The total dry weight for the whole area was 7·19 gm per m².

## The Fauna of the Smith Bank Area

The numbers of each species in the collections from the twelve stations in this area are given in Appendix V, and the dry weights and numbers for the main animal groups are summarised in Table III. Ten of the stations (Fig. 3) were on the bank or in the shallow water near it in depths of 36-42 m. Two stations, numbers 11 and 12, were in the deep water between the bank and the coast in depths of 70 and 59 m respectively.

The stations can be divided into three groups according to the type of soil. Stations 1, 3, 5, 7, 8, 9 and 10 have a deposit mainly of clean sand. Stations 2, 4 and 6 were on patches of gravel and fine shell mixed with sand, while stations 11 and 12 (in the deep channel) were of sandy mud with appreciable quantities of silt and clay.

TABLE III

Smith Bank area. Dry weights in gm (per 1/5m²) of the main animal groups at each station. The numbers of individuals are given in brackets.

| Station | Mollusca | Polychaeta | Echinodermata | Other groups | Total dry weight |
|---|---|---|---|---|---|
| 1 | 0·236 (50) | 0·304 (67) | 0·005 (41) | 0·003 (33) | 0·548 |
| 3 | 0·181 (40) | 0·343 (37) | 0·003 (19) | 0·005 (8) | 0·532 |
| 5 | 0·035 (27) | 0·173 (63) | 0·918 (22) | 0·002 (6) | 1·128 |
| 7 | 0·117 (26) | 0·149 (26) | 0·001 (10) | 0·001 (4) | 0·268 |
| 8 | 0·258 (26) | 0·128 (55) | 0·004 (29) | 0·046 (10) | 0·436 |
| 9 | 0·383 (62) | 0·117 (49) | 0·005 (51) | 0·011 (12) | 0·516 |
| 10 | 0·230 (36) | 1·197 (51) | 0·137 (29) | 0·010 (6) | 1·574 |
| 2 | 0·326 (60) | 0·176 (83) | 0·003 (22) | 0·007 (20) | 0·512 |
| 4 | 0·251 (37) | 0·373 (91) | 0·017 (41) | 0·033 (21) | 0·674 |
| 6 | 0·338 (10) | 0·249 (144) | 0·003 (9) | 9·117 (18) | 9·707 |
| 11 | 0·110 (67) | 0·213 (80) | 0·001 (8) | 0·044 (22) | 0·368 |
| 12 | 0·111 (44) | 0·217 (50) | 0·522 (6) | 0·075 (27) | 0·925 |

Over the whole area the most abundant animal numerically was *Echinocyamus pusillus*. This was present at every station with a mean of 22 individuals per haul. The numbers were lowest on the soft deposit but the distribution on both sand and shell gravel was fairly even. Although numerous, *Echinocyamus* made up only a small part of the biomass, 0·001% of the dry weight for all invertebrates. Other echinoderms were scarce, and the biomass of this group was due mainly to a few large *Echinocardium cordatum* at three stations.

The bulk of the fauna, apart from the numerous *Echinocyamus*, was made up of polychaetes (averaging 66 individuals and 0·303 gm dry weight per haul) and molluscs (with 40 individuals and 0·215 gm dry weight per haul).

Almost a third of the total polychaete weight was made up of two large individuals *Glycera gigantea* (formalin weight 4·3 gm) and *Chone infundibuliformis* (2·8 gm) both at station 10. With these two large

individuals excluded, the mean dry weight of the polychaetes was 0·212 gm per 1/5m² (almost the sam as that for molluscs) and about half of this polychaete weight was made up of *Nephthys* spp., *Maldanidae Owenia fusiformis*, *Ophelia limacina* and *Travisia forbesi*. Other polychaetes less important by weight bu present in large numbers were *Spiophanes bombyx*, *Lumbriconereis gracilis*, *Glycera* spp., *Aricidea* spp. an *Goniada maculata*. Some of these polychaetes, notably *Nephthys*, *Spiophanes* and *Owenia* were distributed over all grounds, but others had a more limited distribution. *Ophelia* (the most abundant polychaete and *Travisia*, for example, occurred only on the sand and gravel stations, and were absent from th muddy channel. *Lumbriconereis* on the other hand was abundant on the soft and on the coarse deposits but was not found in quantity on the sandy areas. The shell gravel areas had particularly high polychaet populations. This was found to be so also off the Isle of Man from where Southward (1957) record higher numbers of polychaetes per m² on fine shell gravel than on any other deposit.

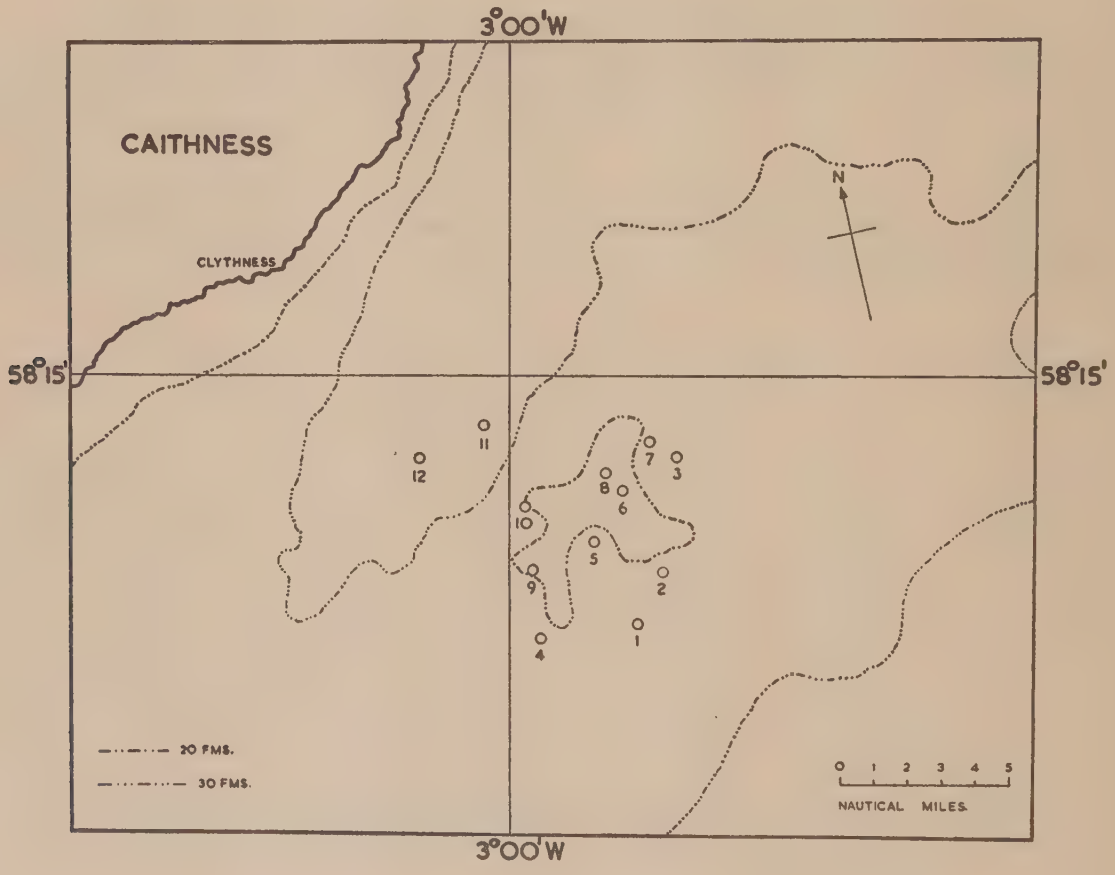


Fig. 3 Stations sampled in the Smith Bank area.

The molluscs averaged 0·215 gm dry weight per 1/5m² and almost 65% of this was made up of *Cochl desma praetenue*, *Gari fervensis*, *Ensis arcuatus*, *Tellina fabula* and *Thyasira flexuosa*. Of these *Cochlodesma* wa by far the most important, occurring on all soils, at all except one station, with a mean number per hau of 15 individuals and accounting for almost half the total number of molluscs. *Thyasira* was restricted t the muddy ground from which several species, particularly *Tellina pygmaea* were notably absent. Th stations with very coarse deposits had some species not found in the finer types of bottom—*Gari tellinell Venus ovata* and *Acropagia crassa*.

Among the other animal groups, amphipods were abundant, being present at all stations with an average of 10 per haul. The commonest species, which occurred at most stations, were *Bathyporeia elegans* and *Ampelisca brevicornis*. At station 6 three *Ammodytes marinus* were taken—a species found not infrequently in samples of shell gravel in which it apparently buries itself. Station 6 had the coarsest deposit in the whole area and its fauna showed many differences from other stations. Apart from the molluscs referred to above as being distinctive of coarse deposits, there was a striking abundance at this station of carnivorous polychaetes—glycerids, syllids, nereids and eunicids.

In the Smith Bank area, as on the other grounds, the fauna consisted mainly of small animals, individuals with dry weights of more than 0·2 gm occurring at only four stations. The dry weight for the whole area was 7·16 gm per $m^2$, or 3·37 gm/$m^2$ if the three *Ammodytes* are excluded.

## TRAWL SAMPLES

Many larger or more active animals are either sampled inadequately by the grab, or are not taken at all. During the work of which the grab survey here described formed a part, a large number of hauls were made over a period of years with a 6 ft Agassiz trawl and a 30 ft "Aberdeen" type otter trawl (80 mm cod-end, with small mesh cover). Although not quantitative in the same way as grab samples (cf. McIntyre 1956) these hauls do give estimates of the relative abundance of the larger benthic animals.

In the St. Andrews and Aberdeen areas during 1954-55 nine surveys were made: 90 one-hour hauls with the otter trawl and 50 ¼-hour hauls with the Agassiz. The trawled fauna was very similar in both areas. The dominant invertebrates, which occurred in almost every haul, were *Asterias rubens*, *Ophiura texturata*, *Astropecten irregularis*, *Crangon vulgaris*, *C. allmani*, *Pandalus montagui*, *Portunus holsatus*, *P. depurator*, *Alloteuthis subulata* and *Loligo forbesi*. Also present, but in smaller numbers, were *Hydrallmania falcata*, *Hydractinia echinata*, *Sertularia cupressina*, various Actiniaria, *Alcyonium digitatum*, sponge, Nemertini, *Aphrodite aculeata*, *Idotea linearis*, *Astacilla longicornis*, *Meganyctiphanes norvegica*, *Macropodia rostrata*, *Pandalina brevirostris*, *Cancer pagurus*, *Corystes cassivelaunus*, *Hyas araneus*, *H. coarctatus*, *Munida bamffica*, *Eupagurus bernhardus*, *Scaphander lignarius*, *Buccinum undatum*, *Lamellaria perspicua*, *Aporrhais pes-pelecani*, *Cardium* sp., *Mactra corallina*, *Sepiola atlantica*, *Eledone cirrhosa*, *Euchratea loricata*, *Flustra foliacea*, *Solaster papposus*, *S. endica*, *Henricia sanguinolenta*, *Ophiura albida*, *Spatangus purpureus*, *Echinocardium cordatum*, *Echinus acutus*, and various tunicates.

During the survey 36 species of fish were caught; the average numbers taken per one-hour haul with the otter trawl give a rough indication of the relative abundance, and these data are given in the following list for the more common species.

| | Aberdeen | St. Andrews |
|---|---|---|
| *Clupea harengus* | 33 | 358 |
| *C. sprattus* | 131 | 636 |
| *Gadus aeglefinus* | 115 | 1 |
| *G. callarias* | 12 | 2 |
| *G. merlangus* | 388 | 109 |
| *G. esmarki* | 21 | <1 |
| *Ammodytes* spp. | 1 | <1 |
| *Gobius minutus* | 1 | 2 |
| *Trigla gurnardus* | 4 | 1 |
| *Agonus cataphractus* | 5 | 2 |
| *Callionymus lyra* | 1 | <1 |
| *Cottus scorpius* | <1 | 1 |
| *Limanda limanda* | 274 | 112 |
| *Hippoglossoides platessoides* | 13 | 3 |
| *Pleuronectes platessa* | 23 | 164 |
| *Microstomous kitt* | 2 | <1 |
| *Platichthys flesus* | 1 | 4 |

Also present, but in average numbers of less than one specimen per hour haul, were—*Raia naevu*
*R. batis*, *Maurolicus muelleri*, *Conger conger*, *Syngnatnus acus*, *Merluccius merluccius*, *Gadus minutus*, *G. viren*
*Molva molva*, *Trachurus trachurus*, *Scomber scombrus*, *Anarhichas lupus*, *Cyclopterus lumpus*, *Pholis gunnellu*
*Glyptocephalus cynoglossus*, *Scophthalmust maximus*, *S. rhombus*, *Buglossidium luteum* and *Lophius piscatorius*.

In the Smith Bank area, eight surveys were made with the otter and Agassiz trawls during 195 and 1952. The dominant invertebrates were, *Alcynonium digitatum*, *Pandalus montagui*, *Portunus holsatu*
*Eupagurus bernhardus*, *E. prideauxi* (usually associated with *Adamsia palliata*), *Chlamys opercularis*, *Loli*
*forbesi*, *Sepiola atlantica*, *Astropecten irregularis*, *Asterias rubens*, *Solaster papposus*, *Hippasterias phrygiana*, *Echinu*
*esculentus* and various tunicata. Also present, but in smaller numbers, were *Suberites ficus*, *Hydractini*
*echinata*, *Halecium halecium*, *H. muricatum*, *Abietinaria abientina*, *Hydrallmania falcata*, *Campanularia verticellata*
*Nemertesia ramosa*, *Sertularia cupressina*, *Thujaria thuja*, *Aphrodite aculeata*, *Nereis fucata*, *Gnathia maxillari*
*Scalpellum scalpellum* (on *Nemertesia ramosa*), *Balanus crenatus*, *Peltogaster paguri*, *Pandalina brevirostris*, *Hippoly*
*varians*, *Crangon allmani*, *Philocheras trispinosus*, *Pontophilus spinosus* (with *Phryxus abdominalis*), *Process*
*canaliculata*, *Portunus depurator*, *Galathea dispersa*, *Galathea nexa*, *Munida bamffica*, *Porcellana longicornis*, *Cance*
*pagurus*, *Atelecyclus septemdentatus*, *Ebalia tuberosa*, *Hyas coarctatus*, *Portunus pusillus*, *Macropodia longirostri*
*M. rostrata*, *Inachus dorsettensis*, *Lithodes maia*, *Nymphon brevirostre*, *Pallene brevirostris*, *Pecten maximus*, *Modiolu*
*modiolus*, *Chlamys tigerina*, *Glycymeris glycymeris*, *Venerupis rhomboides*, *Eledone cirrhosa*, *Alloteuthis subulata*
*Emarginula reticulara*, *Colus gracilis*, *Buccinum undatum*, *Opisthobranchia*, *Eucratea loricata*, *Alcyonidium parasiticum*
*Flustra foliacea*, *Luidia* sp., *Porania pulvillus*, *Anseropoda placenta*, *Solaster endica*, *Henricia sanguinolenta*, *Ophiothri*
*fragilis*, *Ophiopholis aculeata*, *Ophiura affinis*, *Ophiura texturata*, *Spatangus purpureus*, *Echinus elegans*, *Psam*
*mechinus miliaris* and *Cucumaria frondosa*.

Thirty-two species of fish were taken in the Smith Bank otter trawls and the average number o individuals of the main species per one-hour haul is given in the following list:

| | | | |
|---|---|---|---|
| *Ammodytes* spp. | 68 | *Gadus aeglefinus* | 65 |
| *Lophius piscatorius* | 1 | *G. callarias* | 11 |
| *Pleuronectes platessa* | 5 | *G. merlangus* | 33 |
| *Microstomus kitt* | 12 | *G. virens* | 1 |
| *Limanda limanda* | 41 | *G. minutus* | 7 |
| *Hippoglossoides platessoides* | 4 | *G. esmarkii* | 7 |
| *Trigla gurnardus* | 2 | *Callionymus lyra* | 1 |

Also present, but in numbers of less than one per haul were *Squalas acanthias*, *Raia* spp., *Clupea sprattu*
*Argentina* sp., *Merluccius merluccius*, *Gadus luscus*, *G. pollachius*, *Molva molva*, *Zeus faber*, *Trachurus trachuru*
*Gobius minutus*, *Sebastes marinus*, *Triglops murrayi*, *Agonus cataphractus*, *Scophthalmus maximus*, *S. rhombu*
*Zeugopterus punctatus*, *Lepidorhombus wiff-iagonis*, *Glyptocephalus cynoglossus*, *Solea variegata* and *Callionymu*
*maculatus*.

## COMPARISON OF THE THREE AREAS

The faunas of the St. Andrews and Aberdeen coastal areas showed few qualitative differences and a the main invertebrates taken by trawl were common to both grounds. Among the less abundant fis species, *Maurolicus muelleri*, *Conger conger*, *Anarhichas lupus* and *Scophthalmus rhombus* were found only in th St. Andrews samples, while *Raia batis*, *Gadus minutus*, *G. virens*, *Molva molva*, *Trachurus trachurus*, *Scophthalm*
*maximus* and *Glyptocephalus cynoglossus* were taken only off Aberdeen. Apart from these, all fish specie sampled by the trawl were present in both areas. There were, however, differences in relative abundance plaice being more numerous off St. Andrews and common dabs, haddock and whiting off Aberdeen.

The grab samples also showed qualitative similarities. Among the polychaetes for example, not onl were the same species largely present in both areas, but they showed almost the same order of importance *Nephthys*, *Sigalion*, *Notomastus*, *Goniada* and *Phyllodoce* made up the bulk of the weight, and only one specie —*Lanice conchilega* was important in the biomass of one ground (Aberdeen) but not of the other. Aberdeen however, had a rather greater number of polychaetes per unit area, with a weight of just over twice tha

of St. Andrews. Of thirty species of molluscs, 23 were common to both grounds and those peculiar to one ground were small in numbers or size and therefore of little importance in the biomass. The dominant mollusc in each area was a deposit-feeding lamellibranch, *Abra alba* off St. Andrews and *Tellina fabula* off Aberdeen. This difference in distribution of the two species was associated with a marked difference in the soil, *A. alba* being abundant on a much finer grade than *T. fabula* (see page 15).

All the animals which made up a significant part of the mollusc fauna were present in both areas, and except for *Ensis ensis* and *Venus striatula* were more abundant off Aberdeen than off St. Andrews.

Among the echinoderms also the same species occurred on both grounds, with Aberdeen again having larger numbers—three times as many *Echinocardium* and seven times as many ophiuroids. For this phylum, however, St. Andrews had a rather higher dry weight per haul, 0·396 gm compared with 0·298 gm for Aberdeen. This was due to the large size of the St. Andrews *Echinocardium*, which with only a few exceptions were over 20 mm long, while those from Aberdeen were mainly between 11 and 17 mm.

With regard to the less important animal groups, amphipods were comparatively scarce off St. Andrews. Seven species were taken and of those only *Ampelisca brevicornis* (about 3 per haul) and *Harpinia antennaria* were at all common. Off Aberdeen, on the other hand, 23 species of amphipods were found, and among the more numerous species *Nototropis swammerdami* (4 per haul) and *Pariambus typicus* (over 2 per haul), were not present in the St. Andrews samples. The only other marked contrast between the two areas lay in the presence of large numbers of *Edwardsia* and *Phoronis* at a few stations off Aberdeen which had no counterpart off St. Andrews.

To summarise, the standing crop of the fauna of the Aberdeen area in July was qualitatively similar to that off St. Andrews, but rather richer numerically and with a biomass about 65% higher.

On the Smith Bank grounds, the fish population was similar to that of the other two areas, but except for *Microstomus kitt* and *Ammodytes* spp. the average density was rather less. The invertebrate fauna, as sampled by the trawls, was more varied than in the two coastal areas, reflecting the fact that a number of different substrata—gravel and rock, as well as sand and mud—were present. In the grab samples the most striking difference was the numerical dominance of *Echinocyamus pusillus*, and the presence in some quantity of *Tellina pygmaea*, *Cochlodesma praetenue*, *Ophelia limacina* and *Travisia forbesi*, which were absent from the other two areas, or present only in small numbers. On the other hand, certain species important in the coastal areas were scarce or absent on the bank—*Tellina fabula*, *Abra prismatica*, *A. alba*, *Mactra corallina*, *Sigalion mathildae*, *Pectinaria koreni* and *Ammotrypane aulogaster*. The Smith Bank polychaete fauna was numerically greater than that off St. Andrews or Aberdeen, due to the large population of worms on the gravel. With this exception Smith Bank had lower populations of the main animal groups, the mean dry weight of the infauna of the Smith Bank area—3·37 gm/m²—being less than for either of the other areas, and the separate means for the three soil types (sand, mud and gravel) round the bank being also less.

## NOTES ON CERTAIN SPECIES

*Ophelia limacina* (Rathke) was found at all sand or gravel stations in the Smith Bank area, but was absent from the deep water stations with fine deposit, and also from the Aberdeen and St. Andrews stations. The largest specimens found were just under 20 mm long and had 19 branchial setigerous segments followed by 7 abranchial setigers. This lies well within the range (16-24 branchial setigers and 6-7 post-branchial) described by Pettibone (1956).

*Capitomastus minimums* (Langerhans). The only previous British record of this worm is from the Isle of Man (Southward 1956) where it occurred on muddy sand and fine gravel. The Aberdeen and St. Andrews records were all from fine sand or muddy sand.

*Aricidea jefferysi* (McIntosh). Specimens were found in the Smith Bank area in sand, shell gravel and mud. They resemble the description given by Fauvel (1927), but the largest specimen had 24 pairs of gills while the majority had 20-23 pairs. The gills decreased in size posteriorly, the 24th pair being smaller but broader than the dorsal cirrus. The smallest specimens had only 10 pairs of gills, the last two being mere papillae. Previous British record—Isle of Man (Southward 1956).

*Aricidea* sp. These specimens were obtained from both mud and gravel stations. They resembled *A. jefferysi* but each had a longer, pointed, posteriorally directed median antenna without a basal constriction and stretching back to the end of the second setiger. The gills differed from those of *A. jefferysi* being much larger and broader. Ten to fifteen pairs could be counted on most of the specimens, but all the individuals were damaged behind the 16th segment, and none was complete.

*Goniada norvegica* (Œrsted). Two specimens found on shell gravel in Smith Bank. Previous British records—Loch Fyne (Clark 1952), Isle of Man (Southward 1956).

*Magelona rosea* (Moore). Common in both the Aberdeen and St. Andrews areas but present only on the muddy ground off Smith Bank. Previous records—Ireland (Killary Harbour) and Baltic Sea.

*Golfingia* sp. ? These were found at several stations in each of the areas. They varied in length from 6-10 mm and had a conspicuous reddish-brown band round the middle of the body. Dr. A. C. Stephen considers that they may be *Golfingia vulgaris* but the contracted condition of the animals makes identification difficult.

*Synchelidium intermidum* (G. O. Sars). (See Sars 1895 pl. 113, fig. 1.) Four specimens were found on the sandy part of Smith Bank in 38-42 m depth. Previously recorded from Trondhjems Fjord in deep water.

Enteropneusta. These were found at stations 18 and 20 in Aberdeen Bay and at stations 2, 4, 11 and 12 on Smith Bank. All were small and had been damaged during sieving. Dr. C. Burdon-Jones has examined this material and considers that the Aberdeen Bay specimens resemble *Protoglossus koehleri* (Caullery and Mesnil). He states that those from the muddy area off Smith Bank (stations 11 and 12) belong to the genus *Saccoglossus* while the specimen from station 4 (shell gravel) is probably *Glossobalanus sarniensis* (Koehler). The poor condition of the specimens unfortunately makes a completely certain specific identification impossible. Adult enteropneusts have not previously been recorded from these areas, but McIntosh (1927) states that Tornaria larvae have been captured.

As well as the above, the following species were taken in the survey and are not recorded in the Plymouth Fauna List:—*Thujaria thuja* (Linnaeus), *Helicium muricatum* Ellis and Salander, *Sigalion squamatum* Delle Chiaje, *Phyllodoce groenlandica* Œrsted, *Lumbriconereis gracilis* Ehlers, *Staurocephalus keferstein* McIntosh, *Nerinides cantabra* Rioja, *Nerine bonnieri* Mensil, *Spiophanes kroyeri* Grube, *Prionospio malmgreni* Claperède, *P. cirrifera* Wiren, *Chaetozone setosa* Malmgren, *Travisia forbesi* Johnston, *Anobothrus gracilis* (Malmgren), *Myriochele heeri* Malmgren, *Trichobranchus glacialis* Malmgren, *Chone infundibuliformis* Kröyer *C. filicaudata* Southern, *Priapulus caudatus* Lam, *Phoronis mulleri* de Selys Longchamps, *Tryphosites longipes* (Bate and Westwood), *Ampelisca macrocephala* Lilljeborg, *Corophium affine* Bruzeluis, *Eudorellopsis deformis* (Krøyer), *Lithodes maia* Leach, *Hippasterias phrygiana* (Parelius), *Solaster endica* (Linnaeus), *Ophiopholis aculeata* (Linnaeus), *Echinus elegans* Düben and Koren, *Cucumaria frondosa* (Gunnerus), *Amauropsis islandica* (Gmelin), *Cyprina islandica* (Linnaeus), *Astarte montagui* (Dillwyn), *Nucula tenuis* (Montagu), *Maurolicus muelleri* (Gmelin), *Anarhichas lupus* Linnaeus, *Sebastes marinus* (Linnaeus), *Triglops murrayi* Güunther *Hippoglossoides platessoides* (Fabricus).

## DISCUSSION

Previous studies on the bottom fauna of the Scottish east coast were made by Stephen about 30 years ago and described in a series of papers (1923, 1933, 1934). His work covered a wide area, and he was concerned mainly with the distribution of the animals, with special reference to molluscs and echinoderms. The present more concentrated survey is qualitatively in good agreement with his findings, and suggests that there has been no change in the species composition of the fauna. The densities found in the present work are however much greater than those recorded by Stephen. His average number of *Tellina fabula* per $m^2$ was 21, and of *Nucula turgida* was 70, while the corresponding values in the new survey for all stations off the Aberdeenshire coast were 230 and 162 respectively. The difference is perhaps partly due to Stephen having sampled a wider area, but probably also to his use of the Petersen grab, which has been shown (Ursin 1954) to be considerably less efficient than the van Veen.

Stephen at first (1923) accepted the community hypothesis, and the fauna described in the present work off the Aberdeenshire coast fits with his "NEF" community assuming that the "N" refers to *Nucula turgida*, as his later work suggests. After further consideration Stephen (1934) felt that the distribution of

bottom fauna animals in the North Sea could be best described in terms of zones, and there is no doubt that, for parts of the Scottish coast at least, this system can be useful. It is doubtful, however, if it has a more universal application, and it has been criticized by several authors (Blegvad 1934, Jones 1950). It would seem more logical to describe distribution directly in terms of environmental factors and when considering changes in the fauna within a fairly small area the importance of the bottom deposit is generally accepted. This was well demonstrated in the present survey. In the following table are summarised the soil grades of the stations at which three of the dominant lamellibranchs reached their maximum numbers:—

| | Coarse Sand | Fine Sand | Silt and Clay |
|---|---|---|---|
| *T. fabula* area (Aberdeen Bay) .. | 54·4% | 33·0% | 3·5% |
| *N. turgida* area (Aberdeen Bay) .. | 6·2% | 74·4% | 7·4% |
| *A. alba* area .. (St. Andrews Bay) .. | 1·3% | 82·0% | 11·4% |

This shows that the change from the *T. fabula* area to the *N. turgida* area in Aberdeen Bay is associated with a change from soil with a high coarse sand fraction to a deposit largely of fine sand with a higher admixture of silt and clay, and that the *A. alba* population in St. Andrews Bay occurred at maximum density on a still finer grade of deposit.

Jones (1950) has put forward a classification of communities based on environmental factors, and by this classification the fauna off the Aberdeenshire and Fife coasts would seem to be an intergrading of the boreal offshore sand with the boreal offshore muddy-sand association, while the coarser stations of the Smith Bank area can be referred to the boreal offshore gravel association.

The data collected in the present survey will be considered in a later paper in relation to the feeding of fish. In this connection not only is the numerical value of the biomass important, but also the actual species present. This was recognised by Blegvad (1925) when he introduced the idea of 1st and 2nd class fish food. In a later paper (1951) he pointed out that, in the Limfjord, 1st class fish food consists of polychaetes and most lamellibranchs less than 3 cm but that *Nucula* is 2nd class fish food. With this in mind we can suggest that the deeper areas surveyed off the Scottish east coast, where *Nucula* was the dominant lamellibranch, are probably of less value as fish feeding grounds than those shallower than about 15 fathoms, where *Tellina fabula* and certain polychaetes are abundant. Indeed the rich feeding grounds probably extend into very shallow water. The ship used in the present survey could not work in less than 10 m, but it has been shown (Stephen 1929, Clark and Milne 1955) that such species as *Tellina tenuis*, *Nephthys* spp. and *Arenicola marina* are found near low water mark. Dr. A. Ritchie (personal communication) states that where such species are present in the littoral zone on the Scottish east coast their seaward extension overlaps with the shoreward extension of the *Tellina fabula* association. It is of interest to note that off the Aberdeenshire coast the rich *T. fabula* feeding ground, extending out to about 15 fathoms, is entirely within the three mile limit, and is thus "protected" against trawling.

Quantitative estimates of the benthos have been made by various workers in a number of different areas. Saunders (1956), working in Long Island Sound, found values for the infauna of 3·9 to 27·6 grams dry weight per $m^2$. Holme (1953) in the English Channel got a mean dry weight of 11·2 grams per $m^2$ but this included many large animals of the epifauna and his corresponding value for small animals (less than 0·2 gram dry weight) was in the region of 4 grams per $m^2$. Jones (1956), working in a muddy sand deposit off Port Erin, found dry weight values between 2·7 and 18·4 grams per $m^2$. The biomass in the present work ranged from 4·7 to 7·2 grams per $m^2$ and was made up largely of small animals less than 0·2 grams dry weight. The areas off the Scottish east coast at the time studied were thus roughly intermediate between the extreme values recorded elsewhere.

## SUMMARY

From a grab survey made in July 1954 of three fishing grounds off the Scottish east coast a description is given of the standing crop of bottom fauna animals. This is the first account of a series of studies on the fluctuations and productivity of the benthos and the feeding of fish.

The general and hydrographic conditions of the area, and the commercial fisheries, are briefly noted.

Both the St. Andrews and Aberdeen areas had a fairly uniform deposit varying from fine sand to muddy sand, that of the Aberdeen area being slightly coarser. In the Smith Bank area a number of different soils were sampled, varying from gravel to sandy mud.

Off St. Andrews and Aberdeen the fauna was dominated by lamellibranchs and polychactes. It was qualitatively very similar in both areas but quantitatively richer off Aberdeen. Here the 5-10 fathom zone supported a rich fauna dominated by *Tellina fabula* associated with *Lanice conchilega*, *Sigalion mathildae*, *Notomastus latericeus* and *Nephthys* spp. In deeper water the fauna was poorer and dominated by *Nucula turgida*. This change was associated with a change in the bottom deposit. Off St. Andrews the dominant animal was *Abra alba* and again the richest fauna was found in the shallower water.

In the Smith Bank area *Echinocyamus pusillus* was the dominant animal numerically, but by weight polychaetes and molluscs were again most important, with the lamellibranch *Cochlodesma praetenue* making up a large part of the weight.

The mean dry weights per $m^2$ of the invertebrates for the St. Andrews, Aberdeen and Smith Bank areas were 4·69 gm, 7·19 gm and 3·37 gm respectively. The fauna consisted mainly of small animals of less than 1 gm "formalin weight".

Agassiz and otter trawls were used to sample the larger or more active fauna, and lists are given indicating the relative abundance of the species.

The standing crops of the three areas are compared and the survey is discussed in relation to previous work off the Scottish east coast and in other areas.

## REFERENCES

Allen, J. A. 1954. 'A comparative study of the British species of *Nucula* and *Nuculana*.' J. Mar. biol. Ass. U.K., **33**, 457-472.

Blegvad, H. 1925. 'Continued studies on the quantity of fish food in the sea bottom.' Rep. Danish biol. Sta., **31**, 27-56.

—— 1934. Review of Stephen's "Studies on the Scottish marine fauna". J. Cons. int. Explor. Mer, **9**, 414-416.

—— 1951. 'Fluctuations in the amounts of food animals of the bottom of the Limfjord in 1928-1950.' Rep. Danish biol. Sta., **53**, 3-16.

Clark, R. B. 1952. 'New records of sub-littoral polychaetes from the Clyde sea area, with a description of a new species.' Proc. roy. Soc. Edinb., B., **65** (1), 1-26.

Clark, R. B. and Milne, A. 1955. 'The sublittoral fauna of two sandy bays on the Isle of Cumbrae, Firth of Clyde.' J. Mar. biol. Ass. U.K., **34**, 161-180.

Fauvel, P. 1927. 'Polychètes sédentaires.' Faune Fr., **16**, 1-494.

Holme, N. A. 1953. 'The biomass of the bottom fauna in the English Channel off Plymouth.' J. Mar. biol. Ass. U.K., **32**, 1-49.

Jones, N. S. 1950. 'Marine bottom communities.' Biol. Rev., **25**, 283-313.

—— 1956. 'The fauna and biomass of a muddy sand deposit off Port Erin, I.O.M.' J. Anim. Ecol., **25**, 217-252.

McIntosh, W. C. 1927. 'Additions to the marina fauna of St. Andrews since 1874.' Ann. Mag. nat. Hist. Ser. 9, **20**, 113-152.

McIntyre, A. D. 1956. 'The use of grab, trawl, and camera in estimating marine benthos.' J. Mar. biol. Ass. U.K., **35**, 419-429.

Morgans, J. E. C. 1956. 'Notes on the analysis of shallow-water soft substrata.' J. Anim. Ecol., **25**, 367-387.

Pettibone, M. H. 1956. 'Marine polychaete worms from Labrador.' Proc. U.S. nat. Mus., **105** (3361) 531-584.

Sars, G. O. 1895. 'An account of the crustacea of Norway. I Amphipoda.' Oslo.

SAUNDERS, H. L. 1956. 'Oceanography of Long Island Sound 1952-1954. X. Marine Bottom Communities.' Bull. Bingham oceangr. Coll., **15**, 345-414.

SOUTHWARD, E. C. 1956. 'On some polychaeta of the Isle of Man.' Ann. Mag. nat. Hist., Ser. 12, **9**, 257-279.

—— 1957. 'The distribution of polychaeta in offshore deposits in the Irish Sea.' J. Mar. biol. Ass. U.K., **36**, 49-75.

STEPHEN, A. C. 1923. 'Preliminary survey of the Scottish waters of the North Sea by the Petersen grab.' Sci. Invest. Fish. Scot., 1922 (3), 21.

—— 1929. 'Studies on the Scottish marine fauna: The fauna of the sandy and muddy areas of the tidal zone.' Trans. roy. Soc. Edinb., **56** (2), 14, 291-306.

—— 1933. 'Studies on the Scottish marine fauna: The natural faunistic divisions of the North Sea as shown by the quantitative distribution of molluscs.' Trans. roy. Soc. Edinb., **57** (3), 601-616.

—— 1934. 'Studies on the Scottish marine fauna: Quantitative distribution of the echinoderms and the natural faunistic divisions of the North Sea.' Trans. roy. Soc. Edinb., **57** (3), 777-787.

URSIN, E. 1954. 'Efficiency of marine bottom samples of the van Veen and Petersen types.' Medd. Komm. Havundersøg., Kbh. (N.S.), **1** (7), 1-8.

# APPENDIX I

## STATION LIST

| Station No. | Aberdeen Area Position | Depth in m. |
|---|---|---|
| 1 | 57°17′N 01°58′W | 15 |
| 2 | 57°16′N 01°59′W | 15 |
| 3 | 57°15′N 02°00′W | 13 |
| 4 | 57°14½′N 02°00′W | 17 |
| 5 | 57°14′N 02°01′W | 11 |
| 6 | 57°12′N 02°01′W | 18 |
| 7 | 57°11½′N 02°02′W | 18 |
| 8 | 57°17½′N 01°56′W | 26 |
| 9 | 57°16′N 01°57′W | 29 |
| 10 | 57°15′N 01°56′W | 31 |
| 11 | 57°14½′N 01°58′W | 27 |
| 12 | 57°13′N 01°59′W | 29 |
| 13 | 57°11½′N 02°00′W | 29 |
| 14 | 57°10′N 02°01′W | 33 |
| 15 | 57°16½′N 01°54′W | 35 |
| 16 | 57°15½′N 01°54′W | 44 |
| 17 | 57°14′N 01°55′W | 46 |
| 18 | 57°12′N 01°59′W | 46 |
| 19 | 57°11′N 01°59′W | 37 |
| 20 | 57°9½′N 01°59′W | 37 |

| Station No. | St. Andrews Area Position | Depth in m. |
|---|---|---|
| 1 | 56°24′N 02°44′W | 11 |
| 2 | 56°22½′N 02°44′W | 13 |
| 3 | 56°21′N 02°44′W | 13 |
| 4 | 56°20′N 02°42′W | 15 |
| 5 | 56°21½′N 02°39′W | 17 |
| 6 | 56°22½′N 02°40′W | 18 |
| 7 | 56°25′N 02°40′W | 15 |
| 8 | 56°26′N 02°39′W | 11 |
| 9 | 56°27′N 02°37′W | 20 |
| 10 | 56°24′N 02°38′W | 20 |
| 11 | 56°25′N 02°36′W | 22 |
| 12 | 56°22½′N 02°37′W | 22 |
| 13 | 56°21′N 02°36′W | 22 |
| 14 | 56°20′N 02°33½′W | 29 |
| 15 | 56°22′N 02°33½′W | 27 |
| 16 | 56°24′N 02°33½′W | 27 |
| 17 | 56°27′N 02°33½′W | 23 |
| 18 | 56°26′N 02°30′W | 29 |
| 19 | 56°23′N 02°30′W | 31 |
| 20 | 56°20′N 02°30′W | 35 |

| Station No. | Smith Bank Area Position | Depth in m. |
|---|---|---|
| 1 | 58°07½′N 02°52½′W | 38 |
| 2 | 58°09′N 02°51′W | 40 |
| 3 | 58°12½′N 02°50′W | 42 |
| 4 | 58°07′N 02°58′W | 41 |
| 5 | 58°10′N 02°55′W | 42 |
| 6 | 58°11½′N 02°53½′W | 38 |
| 7 | 58°13′N 02°52′W | 36 |
| 8 | 58°12′N 02°55½′W | 42 |
| 9 | 58°09′N 02°58½′W | 40 |
| 10 | 58°11′N 02°59′W | 37 |
| 11 | 58°13½′N 03°01½′W | 70 |
| 12 | 58°12½′N 03°05′W | 59 |

# APPENDIX II

## SOIL GRADES

The results are expressed as percentages by weight of the sample passing through a 2mm sieve. The difference between the sum of the fractions for each sample and 100 is due mainly to $C_a CO_3$ and organic matter, both of which are destroyed in the preliminary treatment. Four of the samples (indicated by asterisks) had fractions greater than 2mm and these were weighed and are given in brackets as percentage of the original sample.

| Station No. | Coarse Sand 2-0·2mm | Fine Sand 0·2-0·05mm | Coarse Silt 0·05-0·02mm | Silt 0·02-0·002mm | Clay <0·002mm |
|---|---|---|---|---|---|
| **Aberdeen Area** | | | | | |
| 1 | 52·50 | 33·36 | 1·0 | 0·6 | 0·6 |
| 2 | 48·18 | 38·80 | 1·0 | 1·8 | 1·6 |
| 3 | 58·40 | 29·00 | 1·2 | 0·1 | 2·7 |
| 4 | 56·80 | 29·24 | 2·0 | 1·8 | 1·0 |
| 5 | 56·10 | 31·30 | Nil | 0·9 | 2·3 |
| 6 | 28·24 | 58·00 | 1·0 | 2·0 | 1·0 |
| 7 | 50·22 | 37·64 | 2·0 | 0·6 | 1·0 |
| 8 | 0·68 | 78·86 | 3·8 | Nil | Nil |
| 9 | 0·68 | 84·90 | 2·4 | 2·3 | 0·8 |
| 10 | 0·72 | 82·76 | 1·0 | 1·6 | 2·4 |
| 11 | 0·96 | 79·82 | 4·0 | 0·8 | 2·4 |
| *12 (1·5) | 19·20 | 60·18 | 3·1 | 0·3 | 2·7 |
| 13 | 67·22 | 18·36 | 3·0 | Nil | 3·0 |
| 14 | 84·98 | 6·95 | 0·6 | Nil | 1·0 |
| 15 | 1·00 | 77·12 | 4·0 | 1·2 | 1·6 |
| 17 | 3·78 | 75·00 | 6·1 | 1·9 | 3·1 |
| 18 | 17·94 | 58·78 | 2·9 | 1·0 | 2·7 |
| 19 | 44·94 | 40·06 | 3·0 | 1·6 | 2·0 |
| 20 | 67·20 | 19·30 | 2·0 | 1·0 | 2·0 |
| **St. Andrews Area** | | | | | |
| 1 | 2·49 | 89·50 | 1·1 | 1·0 | 3·0 |
| 2 | 4·54 | 83·80 | 3·0 | 1·0 | 2·0 |
| 3 | 2·86 | 81·36 | 5·1 | 2·0 | 2·0 |
| 5 | 2·50 | 80·76 | 5·0 | 1·6 | 3·0 |
| 6 | 2·60 | 74·62 | 11·0 | 3·0 | 3·8 |
| 7 | 1·84 | 86·68 | 3·0 | 1·6 | 1·6 |
| 8 | 0·78 | 83·92 | 6·7 | Nil | 3·8 |
| 10 | 0·54 | 85·80 | 6·0 | 1·0 | 2·8 |
| 11 | 0·68 | 89·94 | 1·0 | 1·3 | 1·2 |
| 12 | 0·76 | 78·74 | 6·1 | 1·8 | 4·8 |
| 13 | 0·40 | 81·02 | 6·0 | 1·2 | 3·0 |
| 14 | 0·74 | 71·76 | 9·1 | 3·8 | 5·1 |
| 15 | 0·24 | 84·10 | 6·0 | 0·4 | 2·2 |
| 16 | 0·04 | 74·14 | 13·0 | 0·9 | 2·2 |
| 17 | 0·54 | 88·92 | 1·9 | 0·9 | 2·2 |
| 18 | 0·64 | 82·84 | 5·6 | Nil | 1·2 |
| 20 | 0·46 | 76·70 | 10·6 | Nil | 3·2 |
| **Smith Bank Area** | | | | | |
| 1 | 61·78 | 27·56 | 0·6 | Nil | Nil |
| * 2 (5·5) | 69·72 | 19·98 | Nil | Nil | Nil |
| 3 | 77·66 | 5·12 | Nil | Nil | Nil |
| * 4 (16·0) | 51·90 | 10·72 | 0·6 | Nil | Nil |
| 5 | 84·14 | 4·10 | Nil | Nil | Nil |
| * 6 (25·4) | 72·20 | 2·06 | Nil | Nil | Nil |
| 7 | 72·00 | 4·80 | Nil | Nil | Nil |
| 8 | 80·00 | 4·98 | Nil | Nil | Nil |
| 9 | 62·60 | 15·14 | 0·6 | Nil | Nil |
| 10 | 89·74 | 3·62 | 0·6 | Nil | Nil |
| 11 | 10·04 | 35·22 | 1·0 | 0·4 | 2·2 |

# APPENDIX III

## ST. ANDREWS AREA. NUMBERS OF ANIMALS PER 1/5 m² AT EACH STATION

| Station Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hydrallmania falcata* | | | | | | | + | | | | | | | | | | | | | |
| *Sertularia cupressina* | | | | | | | | | | | | | | + | | | | | | |
| *Edwardsia* sp. | | | | | | | | | | | | | | 1 | | | | | | 1 |
| Anemone | | | | | | | | | | | | | | 1 | | | | | | |
| Nemertini | | | | | 1 | | | | 1 | 1 | 1 | | | 1 | | | | | | 1 |
| *Harmothoë* sp. | | | | | | 1 | | | | | | | | 3 | | | | | | |
| Polynoinae | | | | | | | | 2 | | 1 | | | | | | | | | | |
| *Sigalion mathildae* | 1 | 3 | 6 | 5 | 3 | 2 | | 2 | 4 | | 1 | | 1 | | | | 3 | 1 | | |
| *Sthenelais limicola* | | 1 | | | | 1 | | 1 | 1 | 1 | 2 | | | | | | | 1 | | 2 |
| *Pholoë minuta* | 1 | | | | | 4 | | 1 | | 1 | | 2 | | 16 | | | | | | |
| *Phyllodoce groenlandica* | | | | | | | 3 | | | | | | | | 1 | 4 | | | | |
| *Phyllodoce* sp. | 1 | 1 | 1 | | | 5 | | 4 | 1 | 8 | 1 | 1 | | | 1 | | 1 | | 1 | 1 |
| *Eteone* sp. | | | | | | | | 3 | | 1 | | | | | | 2 | | | | |
| *Syllis cornuta* | | | | | | | - | | | | | | | 1 | | | | | | |
| Nereidae | | | | | | | | 1 | | | | | | | | | | | | |
| *Nephthys hombergi* | 13 | 5 | 2 | | 1 | 3 | 1 | 4 | 3 | 5 | 1 | | | 4 | 4 | 5 | 2 | 4 | 7 | 7 |
| *Nepthys* sp. | 4 | 5 | | 1 | 2 | 2 | 4 | | | 3 | 1 | 4 | 1 | 3 | 1 | 2 | | | 1 | |
| *Nephthys* sp. juv. | | | 2 | | | | 8 | | 1 | | 2 | | 3 | 2 | | 1 | 4 | 2 | 3 | |
| *Ephesia gracilis* | | | | | | | | | | | | | | 5 | | | | | | |
| *Glycera convoluta* | | | | | | | | | | 1 | | | | | | 1 | | | | 1 |
| *Goniada maculata* | 1 | 2 | | | 2 | 2 | 3 | 4 | 2 | 5 | 2 | 2 | 2 | 5 | 11 | 4 | 1 | 4 | 2 | 4 |
| *Glycinde nordmanni* | | | | | | 1 | | | 2 | 1 | 1 | | 1 | 3 | 1 | 1 | 1 | | 3 | 2 |
| *Lumbriconereis impatiens* | | | | | | | | | | | | | | 2 | | | | 1 | 2 | |
| *Scoloplos armiger* | 2 | | | 2 | 2 | 7 | 25 | 2 | 6 | 7 | 4 | 8 | 12 | 26 | 1 | 1 | 8 | 5 | 1 | 2 |
| *Spio filicornis* | 2 | 1 | | | | | | 3 | 1 | | 1 | | | | | | | | | |
| *Spiophanes bombyx* | 26 | 16 | 7 | 3 | 1 | 19 | 13 | 28 | 21 | 40 | 19 | 14 | 1 | 10 | 1 | 2 | 3 | 2 | 9 | 2 |
| *S. kröyeri* | | | | | | | | | | | | | | 3 | | | | | | |
| *Prionospio malmgreni* | | | | | | 3 | | | 1 | | 2 | | | | | | | 2 | 1 | 1 |
| *P. cirrifera* | | | | | | | | | | | | | | 1 | | | | | | |
| Paraonidae | | | | | | | | | | | | | | 5 | | | | | | |
| *Magelona papillicornis* | 11 | 6 | 26 | 16 | 2 | 2 | 1 | | 22 | | 3 | | | | | | 22 | | | |
| *M. rosea* | 2 | | | 4 | 1 | 5 | | 2 | 11 | | | | | | | 1 | 5 | 2 | 2 | 1 |
| *Poecilochaetus serpens* | 1 | | | | | | | | | | | | | | | | | | | |
| *Chaetozone setosa* | 19 | 1 | 2 | 2 | | | 2 | 7 | 16 | 2 | 3 | 1 | 2 | 2 | | | 1 | 8 | 1 | |
| *Diplocirrus glaucus* | | | | | 2 | | | | | 1 | | | | 2 | | 1 | | 1 | 3 | 5 |
| *Scalibregma inflatum* | 5 | 1 | | | | 2 | 4 | 3 | 1 | 9 | | 2 | | 2 | | 1 | | 1 | 1 | |
| *Ammotrypane aulogaster* | | | | | | | | 1 | | 1 | | | 2 | | | | 1 | | | |
| *Notomastus latericeus* | 3 | 5 | 25 | 2 | 2 | 5 | 1 | 3 | | 1 | | 2 | 1 | 1 | 2 | | 1 | | | |
| *Capitomastus minimus* | 1 | | | | | | 2 | 3 | 1 | 1 | | | | 2 | | | | | | 1 |
| Maldanidae | | | | | | | | | | | | | | 3 | | | | | | |
| *Owenia fusiformis* | | | | | | | | | | | | | | 2 | | | | | 1 | |
| *Myriochele heeri* | 1 | | | | 1 | | 3 | 1 | 1 | | 1 | | 1 | 50 | | 1 | 3 | 1 | 1 | 2 |
| *Pectinaria koreni* | 1 | | | | | | 3 | 4 | | 1 | | | | | | 1 | 1 | | | 1 |
| *Ampharete grubei* | | | | | | | | | | | | | | 1 | | | | | 1 | |
| *Anobothrus gracilis* | | | | | | | | | | | | | | 1 | | | | | | |
| Ampharetidae | | | | | | | | | | | | | | 1 | | | | | | |
| *Lanice conchilega* | | | | | | 1 | 2 | | | | | | | | | | | | | |
| *Trichobranchus glacialis* | | | | | | | | | | | | | | 3 | | | | | | |
| *Lysilla loveni* | | | | | | | | | | | | | | 2 | | | | | | |
| Terebellidae | | | | | | | | | | | | | | 1 | | 1 | | | 1 | |
| *Chone* sp. | | | | | | | | | | | | | | | | | | | 1 | |
| *Golfingia* sp. | | | | 2 | | 2 | | | 3 | | | | 2 | 2 | | | 2 | | | |
| *Phoronis mulleri* | | | | | | 1 | | | 4 | | | | | 2 | | 1 | 3 | | 4 | |
| *Iphinoë trispinosa* | | 1 | | | | | | | | | | | | | | | | | | |
| *Diastylis bradyi* | 1 | 1 | 1 | | | 1 | | 1 | | | 1 | | | | | | | | | 1 |
| *Hippomedon denticulatus* | | | | 1 | | | | | | | | | 1 | | | | 1 | 1 | 2 | 2 |
| *Tryphosites longipes* | | | | | | | | | | | | | | | 1 | | | | | |
| *Ampelisca brevicornis* | 12 | 7 | 7 | 3 | | 3 | | 10 | | 2 | | 8 | 1 | 1 | | | | 3 | | |
| *Bathyporeia guilliamsoniana* | | | | 1 | | | | | | | | | | | | | | | | |
| *B. elegans* | 1 | | | | | | | | | | | | | | | 1 | | | | |
| *Harpinia antennaria* | | | | | | | | | | | | | | 2 | 1 | | | 8 | 2 | 2 |
| *Siphonoecetes* sp. | | | | | | | | | | | | | | | | 1 | | | | |
| *Schistomysis ornata* | | | | | | | 1 | | | | | | | | | | | | | |
| *Eupagurus* sp. | 1 | | | | | | | | | | | | | | | | | | | |
| *Corystes cassivelaunus* | 1 | | 4 | | 1 | | | 2 | 2 | 1 | 2 | 1 | | | 1 | 3 | 1 | 2 | 1 | 8 |
| *Zoea larva*: unidentified | | | 1 | | | 1 | 1 | | | | | | | | | | | | | |

APPENDIX III *(Continued)*

| Station Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Natica alderi* | | | | | | | | | | | | | 1 | | | 1 | | | | |
| *Acteon tornatilis* | | | | | | | | | | | | | | | | | | 1 | | |
| *Cylichna cylindracea* | | | | 1 | | 1 | | | | | | | | 2 | | | 2 | | | |
| *Philine scabra* | | | | | | | | | | | | | | | | | | 1 | | |
| *Dentahium entalis* | | | | | | | | | | | | | | | | | 1 | | 4 | 1 |
| *Nucula turgida* | 8 | 2 | 5 | 32 | 32 | 38 | 3 | 27 | 73 | 14 | 27 | 34 | 10 | 9 | 24 | 41 | 65 | 57 | 42 | 17 |
| *N. tenuis* | | | | | 1 | | | | | | | | | 5 | | | | 3 | 4 | 1 |
| *Thyasira flexuosa* | | | | | | 8 | | | | 6 | | 3 | | 39 | 2 | 3 | 4 | 10 | 9 | 13 |
| *Lucinoma borealis* | | | | | | | | | | | | | | 4 | | | | | | |
| *Montacuta ferruginosa* | | 1 | 4 | | | | | 5 | | | | 2 | 1 | 1 | | 2 | 2 | | | |
| *Mysella bidentata* | | | | | | | 1 | 1 | | | | | | 23 | | | 1 | | 1 | |
| *Cyprina islandica* | | | | | | | | | 2 | | 1 | | 1 | 2 | | | 1 | | 1 | |
| *Dosinia lupinus* | | | | | | | | | | | | | | 3 | | | 1 | 5 | 2 | |
| *Venus striatula* | 3 | 9 | 9 | 23 | 3 | 4 | 1 | | 9 | 3 | 2 | 7 | | 3 | 7 | 3 | 7 | 11 | 15 | 7 |
| *Mysia undata* | | 1 | | | 1 | | | | | | 2 | | | 4 | 1 | | 4 | | 1 | |
| *Tellina fabula* | 22 | 30 | 18 | 32 | 4 | 19 | 23 | 63 | 40 | 7 | 27 | 4 | 8 | | 1 | 6 | 54 | 24 | 6 | 2 |
| *Abra alba* | 7 | 11 | 14 | 9 | 3 | 58 | 83 | 44 | 8 | 171 | 10 | 40 | 5 | 16 | 6 | 7 | 3 | 5 | 9 | 16 |
| *A. prismatica* | | 1 | | | | | | | 10 | | 4 | | | | 14 | 7 | 29 | | | 14 |
| *Abra* sp. | 5 | | | 4 | 3 | | | | | 4 | | | | | 1 | | 1 | 47 | 37 | 16 |
| *Gari fervensis* | | | | | | | | | | 6 | | 3 | | | | 4 | | 1 | 2 | |
| *Phaxas pellucidus* | | | | | | | | | | 1 | 1 | 1 | | | 1 | 1 | 5 | 1 | 22 | |
| *Ensis ensis* | 1 | | | | | | | | | | | | | | | | | | | |
| *Ensis* sp. | 18 | 10 | 1 | 2 | 1 | 7 | | 4 | 29 | | 7 | 7 | | 2 | 7 | 9 | 18 | 9 | | |
| *Mactra corallina* | | | | | | | | | | 2 | 3 | | | | | | | | | |
| *Cochlodesma praetenue* | | | | | | | | | | | | | | 1 | 1 | | 3 | 3 | 4 | |
| Lamellibranchia juv. | 2 | | | | | | | | 1 | 1 | 1 | | | 2 | | 1 | | | | |
| *Eucratea loricata* | | | | | | | + | | | | | | | | | | | | | |
| *Astropecten irregularis* | | | | | | | | | | | | | | | | | | 1 | | |
| *Amphiura filiformis* | | | | | | | | | | | | | | 100 | | | | 2 | | 2 |
| *Acrocnida brachiata* | | | | | | 1 | | 1 | | | | | | | | | | 1 | 1 | |
| Amphiuridae | | | | | 1 | | | | | | + | | + | | | | + | | | |
| *Ophiura texturata* | 4 | | | | | 2 | 4 | 3 | 2 | | | | | | | | | | | |
| *O. albida* | | | | | | | | | | | | | 1 | 11 | | | | | | |
| *Ophiura* sp. juv. | | | | | 1 | | | | | | | | | 7 | | | | | | |
| *Echinocardium cordatum* | | 1 | 2 | | | 15 | | 2 | | 3 | 1 | 8 | | 3 | 2 | + | 1 | | 1 | 2 |
| *Lepytosynapta inhaerens* | | | | | | | | | | | | | | 2 | | | | | | |
| Molgulidae | | | | | | | | | | | | | | | | | | 1 | | |
| *Syngnathus acus* | | | | | | | | | | | | | | 1 | | | | | | |

# APPENDIX IV

## ABERDEEN COASTAL AREA. NUMBERS OF ANIMALS PER 1/5m² AT EACH STATION

| Station Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Porifera | | | | | | | | | | | | | | | | | | | 1 | |
| *Virgularia mirabilis* | | | | | | | | | | | | 4 | 1 | | | | 2 | | 5 | 2 |
| *Halcampa chrysanthellum* | | | | | | 1 | 8 | | | | | 1 | | | | | | | 6 | |
| *Edwardsia* sp. | | | | | | 1 | | | | | | 4 | 3 | 2 | 8 | 9 | 23 | 40 | 27 | 61 |
| Anemone | 1 | | | | | | | | | | | | 3 | | | | | 2 | | 13 |
| Turbellaria (Polycladida) | | | | | | | 1 | | | | | | | | | | | | 1 | |
| Nemertini | | 1 | | | | | | | | | | | | 1 | | | 1 | | 1 | |
| *Harmothoë lunulata* | | | | | | 2 | | | | | | 1 | | | | | | | | 1 |
| *Lagisca extenuata* | | | | | | | | | | | | | | | | 1 | | 3 | | 1 |
| *Sthenelais boa* | | | | | | | | | | | | | | | | | | | 1 | |
| *S. limicola* | | | 1 | | | | | | 1 | | | | | | | | 3 | 1 | | |
| *Sthenelais* sp. | | | | | | | | | | 1 | | | | | | | | | | |
| *Sigalion mathildae* | | 9 | 11 | 2 | 4 | 3 | 2 | 1 | 1 | 1 | 1 | 4 | | | 1 | 1 | | | | |
| *S. squamatum* | | | | | | | | | | | 3 | | | | | | | | 1 | |
| *Pholoë minuta* | | | 1 | | | 4 | 1 | 2 | | 4 | 5 | 3 | 5 | 1 | | 3 | 5 | 4 | 13 | 2 |
| Polynoinae: unidentified | | 1 | | | | | | | | | | | | | | | | | | |
| *Phyllodoce groenlandica* | 3 | | | 1 | | | | | | | | 1 | | 1 | | | | | | |
| *Phyllodoce* sp. | | 5 | 1 | | 1 | 3 | | | | 1 | | | 1 | 1 | | | | 1 | | |
| *Eulalia sanguinea* | | | | | | | | | | | | | 1 | | | | | | | |
| *Eteone* sp. | | | 4 | 3 | | | | | | | | | | | | | | | | 1 |
| Hesionidae: unidentified | | 1 | | | 1 | 3 | 3 | | | 1 | | 2 | | | 2 | 1 | | 1 | | 1 |
| *Nephthys hombergi* | | | 1 | 3 | 6 | | | | | 3 | | | 3 | 3 | 1 | 3 | 4 | 7 | 2 | |
| *Nephthys* sp. | 5 | 1 | 4 | 3 | 2 | 2 | | 5 | 5 | 3 | 5 | 1 | 2 | | 3 | 2 | 1 | 3 | 4 | |
| *Nephthys* sp. juv. | 3 | 3 | 2 | 2 | 3 | | | | 5 | | 2 | 3 | | 1 | | | | | | |
| *Ephesia gracilis* | | | 1 | | | 2 | | | | | | 1 | | | | | 1 | 2 | 1 | |
| *Glycera convoluta* | | | | | | | | | 1 | | | | | | | | | | | |
| *Goniada maculata* | 1 | 1 | 3 | 2 | 4 | 11 | 2 | 5 | 7 | | 7 | 11 | 3 | 7 | 3 | 10 | 18 | 6 | 14 | 4 |
| *Glycinde nordmanni* | | | 1 | | | | | | | | 1 | 3 | 2 | 1 | | 1 | 4 | 10 | 4 | 6 |
| *Lumbriconereis impatiens* | 1 | | | 1 | | | | | | | | 1 | 1 | | | | | | | |
| *L. gracilis* | | | | | | | | | | | | | | | | | | 10 | 1 | 11 |
| *Scoloplos armiger* | 1 | 2 | 3 | 4 | 1 | 12 | | | 2 | 1 | 1 | 5 | 2 | 11 | 3 | 3 | 1 | 10 | 3 | 4 |
| *Nerine cirratulus* | | | | | | | 1 | | 1 | | | | | 3 | | | | | | |
| *N. bonnieri* | | | | | | | 1 | | | | | | | | | | | | | |
| *Nerinides cantabra* | | 5 | 2 | | | 1 | | | | | | 1 | | | | | | | | |
| *Spio filicornis* | 2 | 2 | 2 | 1 | 2 | | | | | | | | | | | 2 | | | | |
| *Spiophanes bombyx* | 8 | 27 | 31 | 23 | 14 | 3 | 10 | | 4 | 1 | 3 | 2 | 3 | 10 | 1 | | 2 | | | |
| *Prionospio malmgreni* | | | | | | | | | 1 | 4 | 1 | 3 | 2 | | | 1 | 4 | 7 | 1 | |
| *P. cirrifera* | | | | | | | | | | | 2 | 1 | | | 2 | 1 | 1 | | | |
| Spionidae: unidentified | | 2 | | | 2 | | | | | | | | 1 | | | | | | | |
| *Magelona papillicornis* | 4 | 12 | 8 | 2 | 9 | | 3 | | | | | | | 3 | 1 | | | | | |
| *M. rosea* | 2 | 5 | 9 | | 12 | 6 | 26 | 1 | 2 | 2 | 8 | 3 | 13 | 1 | 9 | 3 | 2 | | 1 | |
| *Poecilochaetus serpens* | | | | 1 | | | | | | | | | | | | | | | | |
| *Chaetozone setosa* | 4 | 3 | 13 | 11 | 9 | 6 | 7 | 1 | 3 | 7 | 3 | 10 | 3 | 8 | 5 | 1 | 1 | 4 | | |
| *Diplocirrus glaucus* | | | | | | 1 | | | | | 1 | 9 | 2 | | | 3 | 3 | 7 | 22 | 15 |
| *Scalibregma inflatum* | | | 1 | | | 1 | | | | | 1 | 5 | 2 | | | | | | | 7 |
| *Ammotrypane aulogaster* | | | 2 | | | | | | | 1 | 1 | | | | | 1 | | | | |
| *Notomastus latericeus* | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 6 | 1 | 1 | | | | | | | | | | |
| *Capitomastus minimus* | | | | 1 | | | 1 | | | | | | | 1 | | | | | | 1 |
| *Owenia fusiformis* | 1 | 1 | 1 | 1 | 5 | 2 | 3 | | | | | | | | 1 | 1 | | 3 | | 1 |
| *Myriochele heeri* | | | | | | 2 | 2 | | | | | | 1 | | | | | | | |
| *Pectinaria koreni* | | 2 | 6 | 4 | 2 | 3 | | 1 | | | | 3 | | 2 | 1 | | | 2 | | |
| *Ampharete grubei* | | | | | | 1 | | | | | | 1 | | | | | | | | |
| *Amphicteis gunneri* | | | | | | | | | | | | | | | | | | 1 | | |
| *Lanice conchilega* | 4 | 17 | 23 | 7 | 7 | 8 | 4 | | 1 | | | 2 | 3 | 7 | 1 | | 1 | 1 | | |
| *Lysilla loveni* | | | | | | | | | | | | | | | | | | 1 | | |
| *Chone dumeri* | | | | | | | | | | | | | | 1 | | | | | | |
| Polychaeta: unidentified | | | 2 | | | | | | | | | | 4 | | | | | | | 1 |
| *Priapulus caudatus* | | | | | | | | | | | | | | | | | | | | 4 |
| *Phascolion strombi* | | | | | | | | | | | | | | | | | 1 | | | |
| *Golfingia* sp. | | | | | | | 1 | | | | | | | | | | | 4 | 4 | 36 |
| *Phoronis mulleri* | | | | | 3 | 20 | 6 | | | 4 | 1 | 60 | 1 | | 10 | 20 | 250 | 500 | 40 | 500 |
| *Eudorella truncatula* | | | | | | | | | | | | | | | | | 1 | 4 | | |
| *Diastylis bradyi* | | | 3 | 4 | | | | 1 | | | | | | | | | | | | 1 |
| Tanaidacea | | | | | | | | | | | | | | | | | | | | 2 |
| *Hippomedon denticulatus* | | | | | | | | | | | | | | 2 | | | 1 | | | |
| *Tryphosites longipes* | | | | | | | | | | | | | | | | | | 1 | | |
| *Orchomanella* sp. | | | 1 | | | | | | | | | | | | | | | | | |
| *Ampelisca brevicornis* | | 2 | 4 | | 2 | 4 | 1 | | | | | 2 | 2 | | | | 7 | | | 1 |

APPENDIX IV *(Continued)*

| Station Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *A. tenuicornis* | | | | | | | | | | | | | | | | | | | 1 | |
| *A. macrocephala* | | | | | | | | | | | | | | | | | 1 | | | |
| *A. diadema* | | | | | | | | | | | | | | | | | | 3 | | |
| *Bathyporeia guilliamsoniana* | | 5 | 4 | | 2 | | | | | | | | | 3 | | | | | | |
| *B. tenuipes* | | 1 | | 1 | 1 | | 2 | | 3 | | | 1 | | | | | | | | |
| *B. sarsi* | | | | | | | | | | | | | | 1 | | | | | | |
| *Harpinia antennaria* | | | | | | | | | | | 1 | 1 | 1 | | | | 5 | 3 | 2 | |
| *Leucothoë lilljeborgi* | | 1 | | 1 | | | | 2 | | | | | | | | | | | | |
| *Metopa* sp. | | | | | 1 | | | | | | | | | 1 | | | | | | |
| *Stenothoë marina* | | | 1 | | | | | | | | | | | | | | | | | |
| *Periculodes longimanus* | | | | | 1 | | | | | | | | | | | | | | | |
| *Nototropis swammerdami* | 8 | 21 | 23 | 3 | 9 | 6 | 2 | | | | | | 2 | 5 | | | | | | |
| *Megaluropus agilis* | | | | | | | | | | | | | | | | | | 1 | | |
| Photidae: unidentified | | | | | | | | | | | | | | | | | | 2 | | |
| *Siphonoecetes colletti* | | | | | | | | | | | | | | 3 | | | | | | |
| *Corophium* sp. | | | | | | | | | | | | 2 | | | | | | | | |
| Gammaridea: unidentified | | | 1 | | | | | | | | | | | | | | | | | |
| Hyperiidae: unidentified | | | | | | | | | 1 | | | | | | | | | | | |
| *Pariambus typicus* | 9 | 4 | 3 | 2 | 4 | 1 | | | | | | 2 | 1 | 1 | 1 | 1 | | 5 | | |
| *Schistomysis spiritus* | | 3 | 1 | 7 | 1 | 1 | | | 2 | | | | | | 1 | 1 | | | | |
| *S. ornata* | 3 | | | | | | | | | | | | | | | | | | | |
| *Galathea* sp. (post larva) | | | | | 1 | | | | | | | | | | | | | | | |
| *Eupagurus* sp. | | | | | | | | | | | | 1 | | | | | | | | |
| *Portunus holsatus* | | | | | | | | | | | 1 | | | | | | | | | |
| *Portunus* sp. | | | | | 1 | | | | | | | | | | | | | 1 | | |
| *Inachus* sp. | | | | | | | | | | | | | | | | | | | 1 | |
| *Corystes cassivelaunus* | | 1 | 1 | 2 | | 2 | 2 | | | 2 | | 3 | 2 | | 3 | 1 | 2 | | 3 | |
| Zoea larvae: unidentified | | | 1 | | | | | | | | | | | | | | | | | |
| *Natica alderi* | 2 | 2 | 3 | | | | 2 | 2 | | 1 | | 1 | | 2 | 1 | | 2 | | 3 | |
| *Acteon tornatilis* | | | | | | | | | | | 1 | | 1 | | | | 1 | | | |
| *Cylichna cylindracea* | | | | | | 1 | 3 | | | 1 | 1 | 3 | 3 | | 2 | 2 | 1 | | 1 | |
| *Scaphander lignarius* | | | | | | | | | | | | 1 | | | | | | | | |
| *Dentalium entalis* | | | | | | | | | | | | | | | | | | 11 | | |
| *Nucula turgida* | 4 | 2 | 17 | 15 | 12 | 33 | 13 | 26 | 25 | 114 | 125 | 60 | 24 | 4 | 15 | 49 | 75 | | 29 | |
| *N. tenuis* | 1 | | | 1 | 2 | 8 | 1 | 1 | 2 | 5 | 5 | 10 | 14 | 3 | 1 | 4 | 11 | | 18 | |
| *Thyasira flexuosa* | | | | | | | 1 | | | | 1 | 14 | 9 | 1 | | 2 | 19 | 21 | 25 | |
| *Lucinoma borealis* | | | | | | | | | | | | | | | | | 1 | 1 | | |
| *Montacuta ferruginosa* | 1 | 2 | | | 6 | 21 | 11 | 2 | | 2 | 11 | 7 | 3 | | 1 | | 6 | 3 | 10 | |
| *Mysella bidentata* | | 3 | 7 | | 1 | 9 | 3 | | 3 | | 6 | 5 | 12 | 2 | 10 | 1 | | 6 | 10 | |
| *Cyprina islandica* | | | | 1 | 1 | 1 | | | | | 1 | | | | 1 | | | | 2 | |
| *Cardium* sp. | | | | | | | | | | | | | | | | | | 1 | | |
| *Dosinia lupinus* | | | | | | | 1 | | | | 1 | 2 | 5 | 4 | | 2 | 6 | 3 | 8 | |
| *Venus striatula* | | | 3 | 1 | 2 | 2 | 2 | 2 | | 2 | 2 | 10 | 6 | 15 | 1 | 4 | 8 | 5 | 5 | |
| *Tellina fabula* | 71 | 124 | 136 | 88 | 132 | 73 | 102 | 25 | 14 | 14 | 12 | 10 | 25 | 53 | 8 | 3 | 10 | 1 | 13 | |
| *Abra alba* | | 2 | 6 | 4 | 3 | 17 | 5 | 3 | | | 4 | 8 | 5 | | | 1 | 3 | 2 | 4 | |
| *A. prismatica* | 5 | 9 | 7 | 17 | 8 | | 4 | 5 | 8 | 9 | 9 | 14 | | | | | | 11 | 17 | |
| *Abra* sp. | | | 6 | | 5 | 6 | | | | | | | 10 | 33 | 3 | 6 | 12 | 3 | | |
| *Gari fervensis* | | | | | | | 1 | | | | | 8 | 1 | 1 | | | 3 | 5 | 1 | |
| *Phaxas pellucidus* | | | | 1 | 1 | | 1 | | 1 | | 1 | 2 | 1 | | | | 3 | 8 | | |
| *Ensis ensis* | | | 1 | 1 | | 1 | | | | | | | | | | | | | | |
| *E. arcuatus* | | | | | | | 1 | | | | | 1 | | | | | | | | |
| *E. siliqua* | | | | | | | | | 1 | | | | | | | | | | | |
| *Ensis* sp. | 4 | | 3 | 2 | 4 | | | | 2 | | 2 | | 2 | 3 | | | 1 | | | |
| *Mactra corallina* | 1 | 1 | | | 6 | 1 | | | | | | | 1 | 5 | | 1 | | | 1 | |
| *Cochlodesma praetenue* | | | | | | | 1 | | | | | | | | | | | 1 | 2 | |
| *Spisula elliptica* | | | | | | | | | | | | | | 1 | | | | | | |
| Lamellibranchia juv. | | | | | 1 | 1 | 2 | | | | | 1 | | 5 | | | | | 1 | 1 |
| *Astropecten irregularis* | | | | | | | | | | | | | | | | 1 | 2 | 1 | 1 | |
| *Amphiura chiajei* | | | | | | | | | | | | | 3 | 1 | | | | | 1 | |
| *A. filiformis* | | | | | | | | | | | 8 | | | | | | 2 | 4 | 4 | |
| *Acrocnida brachiata* | | | 2 | 3 | | 1 | | | 1 | | | | | 1 | | 4 | | | | |
| Amphuridae | 3 | + | 3 | | + | | + | 1 | | 2 | | 3 | + | 4 | + | | 4 | | | |
| *Ophiura texturata* | 19 | 20 | 33 | 5 | 5 | | 1 | 2 | 5 | | 5 | | | | | 2 | 1 | 1 | | |
| *O. albida* | | 5 | 21 | | | | | | 3 | | 8 | | | 4 | | | | | | |
| *Ophiura* sp. juv. | 20 | 12 | 20 | 7 | 8 | | 4 | 2 | 5 | | 22 | | | | | 1 | | | | |
| *Echinocardium cordatum* | 1 | 1 | 1 | | 5 | 20 | 7 | 3 | | 6 | 9 | 5 | 7 | | 13 | 1 | 9 | 5 | 22 | 1 |
| *Echinocyamus pusillus* | | | | | | | | | | | | | | | | 1 | | | | |
| *Cucumaria elongata* | | | | | | | | | | | | | | | | | | 1 | | |
| *Leptosynapta inhaerens* | | | | | | 2 | | | | | | 1 | | | | | | 1 | | |
| Enteropneusta | | | | | | | | | | | | | | | | | | 1 | | |

# APPENDIX V

## SMITH BANK AREA. NUMBERS OF ANIMALS PER 1/5m² AT EACH STATION

| Station Number | 1 | 3 | 5 | 7 | 8 | 9 | 10 | 2 | 4 | 6 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydroida | | | | | | | | + | + | | | |
| *Virgularia mirabilis* | | | | | | | | | 1 | | 1 | 8 |
| *Edwardsia* sp. | | | | | | | 1 | | 1 | | 7 | |
| Anemone | | | | | | | | 1 | | | | 3 |
| Nemertini | | | | | 1 | 1 | | + | | | | + |
| *Sthenelais limicola* | | | | | | | 1 | | | | | |
| *Pholoë minuta* | | | | | | | | | 1 | | | |
| Polynoinae | 2 | | 1 | | | | | 2 | 1 | 1 | 1 | |
| *Phyllodoce* sp. | 1 | | 1 | | | | | | 1 | 1 | | |
| *Eulalia* sp. | | | | | | | | | 1 | | | |
| *Eumida* sp. | 2 | | | | | | | | | | | |
| *Eteone* sp. | 1 | | | | | | | | 1 | 3 | | |
| *Mystides* sp. | | | | | | | | | | 3 | | |
| Hesionidae | | | 1 | | | | 1 | | | | 1 | |
| *Syllis* sp. | | | | | | | | | 1 | 7 | | |
| *Nereis* sp. | | | | | | | | 1 | | 8 | | 1 |
| *Nephthys hombergi* | 2 | | | 1 | 1 | | | | | | 2 | |
| *Nephthys* sp. | | 1 | | 1 | | 1 | | | | | | 1 |
| *Nephthys* sp. juv. | 5 | 2 | 6 | 1 | 2 | 2 | | 2 | | 1 | 2 | 2 |
| *Glycera gigantea* | | | | | | | 1 | | | | | |
| *Glycera* sp. | 3 | | 1 | | 2 | 1 | | 5 | 7 | 38 | | 1 |
| *Goniada maculata* | 2 | 6 | 2 | | 5 | 2 | 2 | | | | 2 | 4 |
| *G. norvegica* | | | | | | | | | | 2 | | |
| *Glycinde nordmanni* | 1 | | | | | | 1 | | 6 | | | |
| *Onuphis conchylega* | | | | | | | | | 1 | | | |
| *Lumbriconereis fragilis* | | | | | | | | | | | 4 | |
| *L. gracilis* | 1 | | | | | | | 23 | 19 | | 27 | 9 |
| *Staurocephalus kefersteini* | | | | | | | | | | 23 | | |
| *Scoloplos armiger* | | 1 | 4 | | | | 3 | | 3 | | 4 | 2 |
| *Spiophanes bombyx* | 6 | 7 | 13 | 4 | 10 | 11 | 9 | 11 | 6 | 2 | 9 | 5 |
| *Spio filicornis* | | | | 8 | | 1 | 4 | 1 | | 5 | | |
| *Aonides* sp. | 3 | 1 | | | 1 | | | 4 | | 10 | | |
| *Prionospio cirrifera* | | | | | | | | | 2 | | 1 | |
| *Prionospio* sp. | | | | | | | | | | 1 | | |
| *Polydora* sp. | 2 | | | | | | | 1 | | 3 | | |
| Spionidae: unidentified | | | | | | 1 | | 4 | 2 | | | 1 |
| *Magelona papillicornis* | | 1 | 1 | | | | | | | | | |
| *M. rosea* | | | | | | | | | | | 2 | 1 |
| *Poecilochaetus serpens* | 2 | | | 1 | 2 | | | 2 | 2 | | 1 | 2 |
| *Aricidea jeffreysi* | | | 5 | 2 | 3 | 5 | | 2 | 3 | 5 | 2 | 3 |
| *Aricidea* sp. | | | | | | | | | 2 | | 4 | 4 |
| *Chaetozone setosa* | 1 | 1 | | 2 | 3 | | 5 | 3 | | 1 | 6 | |
| Cirratulidae: unidentified | | | 2 | | 1 | | | | | | 1 | 3 |
| *Diplocirrus glaucus* | | | | | | | | | 1 | | 4 | 2 |
| Chloraemidae | | | | | | | | | 1 | | | |
| *Scalibregma inflatum* | | | | | | | | | 1 | | 2 | |
| *Ophelia limacina* | 10 | 6 | 19 | 5 | 13 | 9 | 14 | 10 | 5 | 6 | | |
| *Travisia forbesi* | 6 | 4 | 6 | | 4 | 6 | 3 | 2 | | | | |
| Opheliidae | | | | | | | | | 1 | | | |
| Maldanidae: unidentified | | 1 | | | | | | 2 | 5 | | 2 | 1 |
| *Owenia fusiformis* | 15 | 4 | 1 | 1 | 8 | 10 | 6 | 3 | 8 | 2 | 2 | 3 |
| *Myriochele heeri* | | | | | | | | | | | | 1 |
| *Anobothrus gracilis* | | | | | | | | 1 | | | | 1 |
| *Notomastus latericeus* | | | | | | | | | 2 | 4 | | 1 |
| Capitellidae | | | | | | | | | | 2 | | |
| *Lanice conchilega* | 2 | | | | | | | | | | | |
| *Thelepus cincinnatus* | | 1 | | | | | | | | | | |
| *Polycirrus* sp. | | | | | | | | | 2 | | | 1 |
| *Pista* sp. | | | | | | | | | 1 | | | |
| Terebellidae | | | | | | | | 4 | | 7 | 1 | 1 |
| *Chone infundibuliformis* | | 1 | | | | | 1 | | | 7 | | |
| *C. filicaudata* | | | | | | | | | | 2 | | |
| *Chone* sp. | | | | | | | | | 5 | | | |
| *Golfingia* sp.? | | | | | | | | 1 | | 1 | | |
| *Phoronis mulleri* | | | | | | | | 1 | 13 | 3 | | |
| *Eudorellopsis deformis* | 2 | | | | | | | | | | | |
| Tanaidacea | | | | | | | | 1 | | | | |
| Gnathiidae | | | | | | | | | 1 | | | |
| *Idotea linearis* | | | | | | | | | | 1 | | |

APPENDIX V *(Continued)*

| Station Number | 1 | 3 | 5 | 7 | 8 | 9 | 10 | 2 | 4 | 6 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hippomedon denticulatus* | 2 | | 1 | | | 1 | | | | | | |
| *Tryphosites longipes* | 3 | | | | | | | 1 | | 1 | 1 | |
| Lysianassidae: unidentified | | | | | | | | 2 | 2 | | | |
| *Ampelisca brevicornis* | 9 | 2 | 3 | 3 | 4 | 1 | | 3 | | | | 1 |
| *A. tenuicornis* | | | | | | | | | | | 1 | |
| *A. diadema* | | | | | | | | | | | | |
| *Bathyporeia guilliamsoniana* | | 1 | | 1 | 2 | 1 | | | | | | |
| *B. elegans* | 10 | 2 | | | 2 | 4 | 4 | 5 | | | | 2 |
| *B. tenuipes* | | | | | | | | 1 | | | 4 | 4 |
| *Urothoë elegans* | | | | | | | | | | | 4 | |
| *Harpinia antennaria* | | | | | | | | | | | 3 | 5 |
| *Synchelidium intermedium* | 2 | | | | 1 | 1 | | | | | | |
| *Periculoides longimanus* | 1 | 2 | | | | 1 | 1 | | | | | |
| *Monoculoides carinatus* | | | | | | | | | | 8 | | |
| Photidae: unidentified | 2 | | | | | | | | | | | |
| *Corophium crassicorne* | 1 | | 2 | | | 1 | | | | | | |
| *C. affine* | | | | | | | | 1 | | | | |
| *Corophium* sp. | | 1 | | | | | | | | | | |
| *Eupagurus* sp. (post larva) | 1 | | | | | | | | | | | |
| *Galathea* sp. (post larva) | | | | | | | | | 1 | | | |
| Zoea: unidentified | | | | | | | | | | 1 | | |
| Polyplacophora | | | | | | | | | 6 | | | |
| *Amauropsis islandica* | | 1 | | | | | | | | | | |
| *Natica alderi* | | | | | | 1 | | 1 | 1 | | 1 | |
| *Natica* sp. | | | | | | 1 | | | | | | |
| *Velutina velutina* | | | | | | | | | 2 | | | |
| *Cylichna cylindracea* | | | | | | | | | | | 2 | 1 |
| *Dentalium entalis* | | | | | | | | | | | 1 | |
| *Nucula turgida* | | | | | | | | | | | | 2 |
| *N. tenuis* | | | | | | | | | | | 4 | 2 |
| *Astarte montagui* | | | | | | 1 | | 1 | | 1 | | |
| *Thyasira flexuosa* | | | | | | | | | | | 11 | 22 |
| *Lucinoma borealis* | | | | | | | | | | | 1 | 1 |
| *Montacuta ferruginosa* | | | 2 | | | | | | | | | 2 |
| *Mysella bidentata* | | | | | | | | | | | | 1 |
| *Cyprina islandica* | 13 | 2 | 3 | | 1 | 2 | | 5 | 1 | | | |
| *Laevicardium crassum* | 1 | | 1 | | | 2 | | | | | | |
| *Cardium* sp. juv. | | | | | | | | | 1 | | | 1 |
| *Dosinia lupus* | 2 | 1 | | 1 | | 3 | 1 | 5 | 1 | 1 | | |
| *Venus striatula* | | | | | 1 | | | | 3 | | | |
| *V. ovata* | | | | | | | | 3 | 2 | | | |
| *Venus* sp. | | | | | | | | | | 1 | | |
| *Mysia undata* | | | | | | | | | 1 | | | |
| *Tellina fabula* | 1 | | 2 | 2 | 3 | 1 | | 10 | | | 17 | 5 |
| *T. pygmaea* | | 7 | 4 | 1 | 1 | 3 | 9 | 1 | 1 | 1 | | |
| *Acropagia crassa* | | | | | | | | | | 1 | | |
| *Abra prismatica* | 5 | 4 | 1 | 6 | 2 | 4 | 4 | 4 | | | 9 | |
| *Abra* sp. | | | 1 | | | | | | | | | 4 |
| *Gari fervensis* | 3 | 2 | | 1 | 1 | 3 | 1 | 1 | | | 3 | |
| *G. tellinella* | | | | | | | | | | 1 | | |
| *Ensis arcuatus* | | | | 1 | | 3 | 2 | | | 2 | | |
| *Ensis* sp. juv. | | | | 2 | | | | | | | | |
| *Phaxas pellucidus* | 2 | 1 | | 1 | | | | 1 | 1 | | 6 | |
| *Spisula elliptica* | | 7 | | 2 | | 2 | | 2 | | 1 | | |
| *Spisula* sp. | | | | | | | 1 | | | | | |
| *Cochlodesma praetenue* | 22 | 15 | 13 | 9 | 17 | 36 | 17 | 25 | 15 | | 12 | 3 |
| *Thracia* sp. | 1 | | | | | | 1 | | 2 | 1 | | |
| Lamellibranchia juv. | | | | | | | | 1 | | | | |
| *Alcyonidium gelatinosum* | | | | | | | | | | | | + |
| *Amphiura filiformis* | | | | | | | | | | | | 2 |
| *A. securigera* | | | | | | | | | 1 | | | |
| Amphiuridae | | | | | | | + | | | | 2 | |
| *Ophiura albida* | | | | | | 1 | | | 5 | | | |
| *Ophiura* sp. juv. | | | 1 | | | 2 | | | | | | |
| *Echinocyamus pusillus* | 41 | 19 | 19 | 10 | 29 | 48 | 27 | 22 | 34 | 9 | 6 | 1 |
| *Echinocardium cordatum* | | | 2 | | | | 1 | | | | | 3 |
| *Leptosynapta inhaerens* | | | | | | | | | 1 | | | |
| Molgulidae | | | | | | 1 | | | | | | |
| Enteropneusta | | | | | | | | 1 | 1 | | 1 | 2 |
| *Ammodytes marinus* | | | | | | | | | | 3 | | |

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